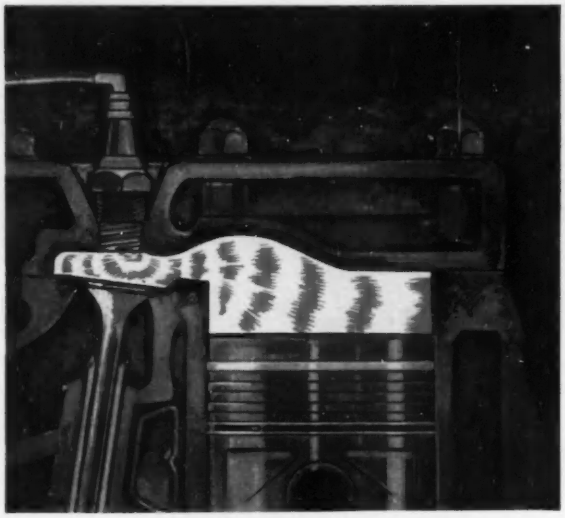
SAE JOURNAL

IN THIS ISSUE

FEBRUARY 1954

PUBLISHED BY THE SOCIETY OF AUTOMOTIVE ENGINEERS

Which is hotter?



Inside an engine?

Inside molten lava?

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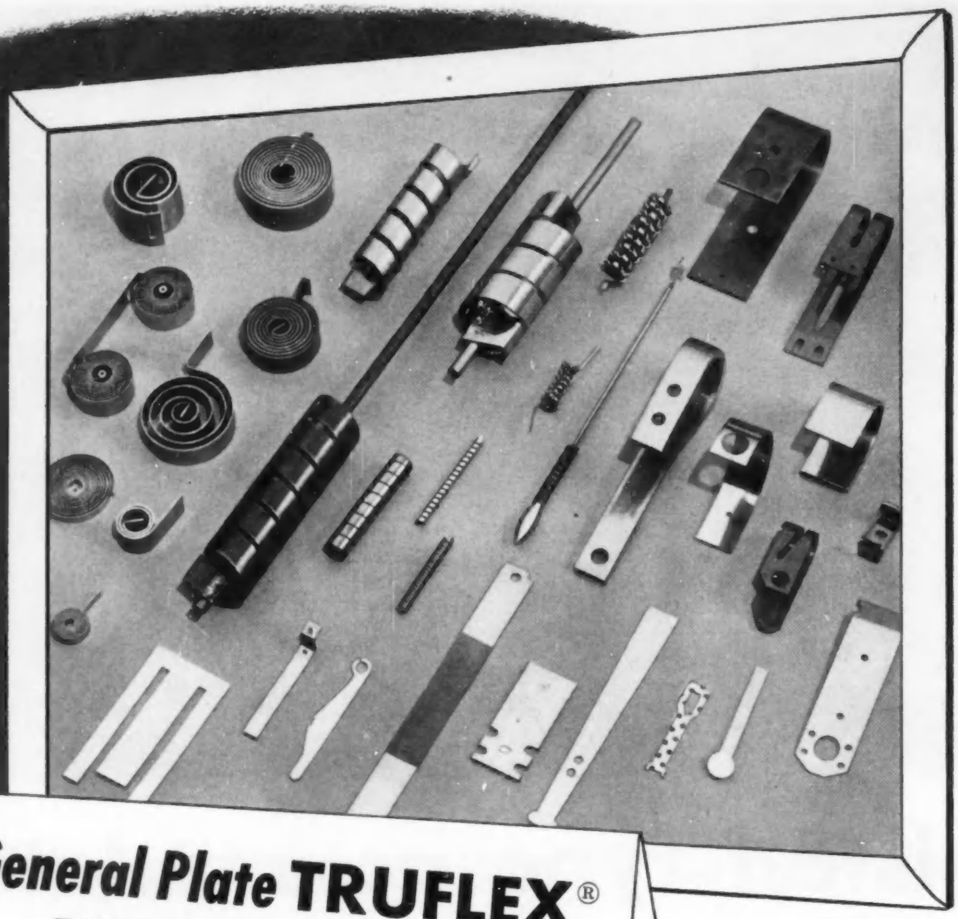

For the Sake of Argument

Criticism . . .

By Norman G. Shidle

Voicing—or even thinking—destructive criticism is generally agreed to be harmful. But CONstructive criticism! Ah, that's another matter, folks usually assure us.

Destructive criticism rarely imbeds itself in the recipient's heart. It rarely causes him to mend his ways. Rather it brushes the surface of his mind as it deflects toward oblivion. . . . And the giver (or thinker) simply darkens his own consciousness with unpleasant thoughts. Everybody loses from destructive criticism.

Constructive criticism, on the other hand, is generally agreed to be useful . . . and probably it is. Few of us, though, are too clear about exactly what constitutes the difference. Particularly, we get befogged when involved either as a giver or a taker. If we're giving the criticism, it's easy to feel it's constructive. And it's just as natural to cry "Destructive" to barbs aimed at us.

"We all love ourselves, notwithstanding our faults. We should do the same thing as regards others." We heard someone quoted as having said that recently. Whoever he is, this wise man has a pretty fair practical yardstick for measuring criticism. It will accurately spot destructiveness or constructiveness when we are honest with ourselves. At least, it will turn our minds in the right direction.

The fellow who can see clearly without judging; view most actions without having reactions may be on the right track. The fellow who thinks mostly about how to help people and little about how they ought to help themselves will be happy with himself oftener than the conscientious critic of all he surveys.

"What the other fellow thinks and does," says Wentworth Winslow, "is none of your business. But it is very much your business what you think the other fellow thinks or does."

SAE JOURNAL

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Business Press, Inc.
10 McGovern Ave.
Lancaster, Pa.

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29 West 39th St.
New York 18, N. Y.
Tel.: LOngacre 5-7174

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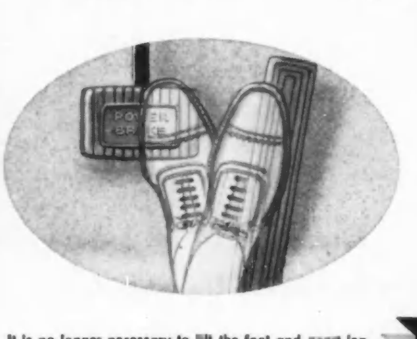
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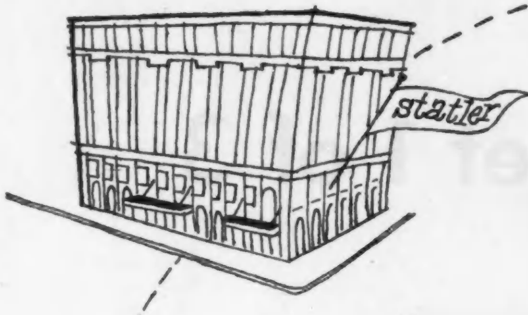
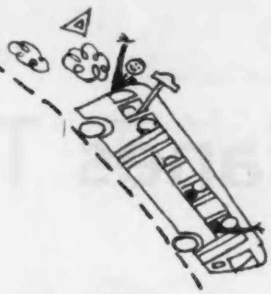


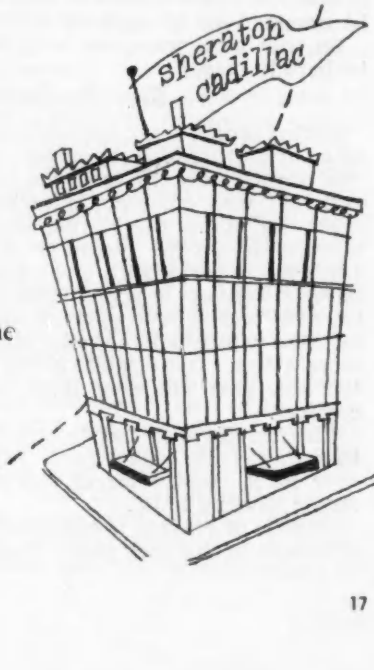


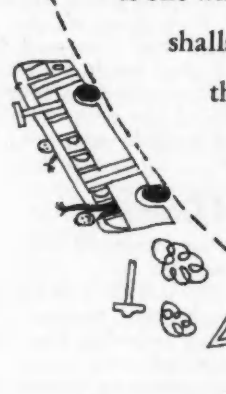
Record Annual Meeting Expands to Two Hotels

More SAE members and guests than ever before participated in SAE's first two-hotel Annual Meeting in Detroit, Jan. 11–15. Back and forth between the Sheraton-Cadillac and the Statler they shuttled by bus and by foot to crowd the 25 technical sessions.

Listening and discussing the 56 papers presented, they spent the week acting like engineers—as defined by 1954 SAE President William Littlewood in his inaugural address.

An engineer, in Littlewood's definition, "is one who—when faced with a problem—marshalls the determinable facts, analyzes them and derives a solution, and then prescribes or executes a course of action." . . . And, throughout the





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Planes Today Get 1 of 3 Underpinning

LANDING gears are obnoxious appendages that are tolerated on airplanes only because we haven't yet found a satisfactory way to get along without them. Since this is the case, it may be well to review the advantages and disadvantages of the various types of landing gear and wheel configuration being used today.

There are three basic types of landing gear now in use—tricycle, bicycle, and diamond.

Tricycle Gear

The tricycle landing gear has almost completely superseded the tail wheel-type gear in the last 20 years. This has been justified for reasons of improved stability, braking, and steering.

A tricycle arrangement may also be substantially lighter than a tail wheel-type gear. This proved the case with a current development aircraft which was characterized by a high angle landing attitude. It does not follow, however, that weight saving will be obtained on all types of aircraft.

Be that as it may, the tricycle gear appears to be here to stay.

Bicycle Gear

During recent years, bicycle-type gear has evolved as an unfortunate compromise on several aircraft. The author uses the term "unfortunate" with regret, but with complete sincerity.

For one thing, the bicycle arrangement limits a pilot to a narrow range of touch-down speeds. (This range varies with gross weight.) If he lands above this range of speed (which might be advisable with turbulent or gusty ground conditions) the airplane will usually porpoise off the ground one or more times. If he lands below this speed range, the nose gear will come down much too hard for comfort.

The bicycle also has lower cross-wind stability than its tricycle counterpart. And the higher nose-gear loads require larger steering torques, hence larger steering units.

Control of braking is complicated by the addition of brakes to the nose gear. There is a large variation in vertical load which is caused by the dynamic reaction of the center of gravity when braking. This may require different size brakes for the front and rear gears even though the same size wheels are used. For that matter, if the nose-gear brakes override the main-gear units, a ground loop can develop rapidly. What's more, the general use of multiple wheels laterally displaced relative to the fuselage can result in skidding of individual tires when the plane rolls. Fortunately, antiskid devices solve most of these brake problems, but they do so at the price of their necessity and dependence on their reliability.

Still another point against the bicycle is that even though the lateral stabilizing or outrigger gears are relatively small and light, they bring the total number of landing units to a minimum of four instead of three. They also increase the number of free-castering gears requiring shimmy damping and centering to three instead of one.

The greatest penalty of the bicycle gear, however, is a hidden one that was discoverd during conversion of the B-36 bomber into the YB-60, a swept-wing all-jet version. A bicycle gear was considered as a possible solution to the problem of the sizable rearward shift of the aircraft center of gravity. (This shift left the tricycle main gears ahead of the center of gravity at all high gross weight conditions.) But studies showed that increased fuselage bending with a bicycle gear would necessitate that structural weight be increased by 4000 lb. This amounted to about 1% of the gross weight or 22½% of total landing-gear weight—a penalty that could not be tolerated.

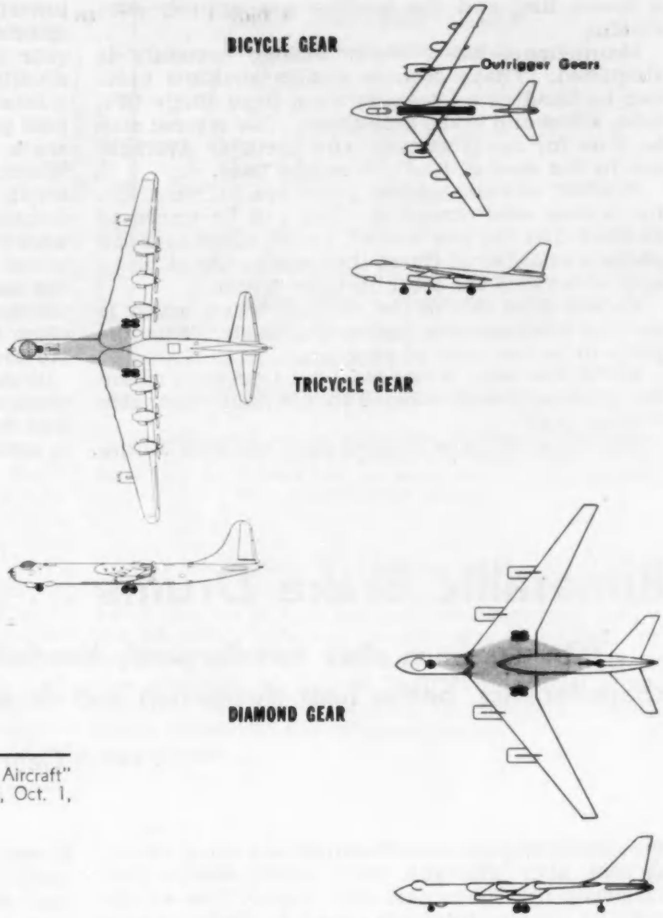
Diamond Gear

The fore-and-aft rigger or diamond gear may prove to be the right answer for some aircraft.

The YB-60 is a good case in point. The landing-gear problem with this jet bomber was solved by leaving the main gears alone, reducing the size of the nose gear, and adding a tail gear.

The tail gear in this arrangement is somewhat unique. It is primarily an air spring of 18 in. stroke,

Devices



Wendell E. Eldred
Consolidated Vultee Aircraft Corp.

Based on paper "Landing Gear Design as Applied to Modern Aircraft" presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 1, 1953.

with a low compression ratio of 1.25 to 1 and dual co-rotating 36-11 tires the same size as the nose gear. This special tail gear, which is fully retracted at the time of actual takeoff and landing, serves two purposes. First, it prevents the plane from falling over backwards due to the aft center of gravity and jet thrust moments. Second, it throws enough vertical reaction on the nose gear to permit adequate steering under center of gravity and runway grade variations.

In operation, the pilot retracts the tail gear at close to 90 mph, at which speed the airplane has ample elevator control under all conditions. The tail gear is not lowered again until after the airplane is landed. This is done at any time suiting the pilot, since the combination of brakes, engine thrust, and forward shift of the center-of-gravity makes the tail gear unnecessary until power steering is needed.

Trend Away from Single-Wheel Gear

Now let's consider what wheel configurations are being used on main and nose landing gear on today's planes . . . and why.

On larger aircraft, the trend for main gear is very definitely away from single wheels to twin, tandem, twin-tandem, and dual twin-tandem wheel patterns. Even triple twin-tandem arrangements are under study. The requirement that aircraft be able to use runways of moderate quality surface and subgrade has brought this about.

Usually the aircraft engineer pays a price by giving in to the civil engineer, but in the case of multiple-wheel gears he came out ahead.

First of all he saved weight. Twenty-five hundred pounds was the prize for converting the B-36 from single 110 in. tires to twin-tandem 56 in. tires. (Eighteen hundred pounds of this weight-saving was in running gear, seven hundred in structure.) As for the deHavilland Comet, 217 lb was gained by converting from one to four wheels on each main gear. (Of this weight, 341 lb was saved on running gear, 124 lb lost in structure.)

A less tangible, but still very real gain is made in safety. A flat tire becomes of little or no consequence. As evidence of this, the author once had the dubious privilege of watching a B-36 land with all rear tires of both main bogie gears blown out. (This happened as a result of inadvertent brake application during the latter portion of the takeoff.) Only reverse-pitch thrust braking was used for landing, since a brake line had been damaged by

a blown tire, and the landing was entirely successful.

Maintenance on a heavy bomber certainly is simplified. That's because smaller multiple units can be handled a lot easier than huge single tire, tube, wheel and brake assemblies. The reverse may be true for small aircraft and probably averages out in the case of medium weight ones.

Tandem or twin-tandem gears are superior, too, for taxiing over obstacles. This can be traced to the fact that the fore and aft wheels climb over the obstacle at different times, thus raising the airplane only about half the total obstacle height.

On the debit side of the multiple-wheel ledger is the increased number and cost of parts. This appears to be the price of progress.

As for tire wear, it has not been a problem where the pilot has been cautioned to maintain reasonable turning radii.

The trend for nose landing gear has been strong towards use of a dual-wheel gear with a vertical spindle axis and power steering. This type of nose gear provides a 100% safety factor on tires and usually makes for best stowage in the structure.

Dual-wheel design also permits use of co-rotating nose gears. These, in turn, when properly designed, are a 100% guarantee against nose-gear shimmy. When used without power steering, weight is definitely saved through elimination of the shimmy damper and associated mechanism. When used with power steering, a small weight penalty is involved. However, with co-rotation and power steering, scissor deflections and joint play due to adverse tolerances or wear do not lead to shimmy as has often been the case when non-co-rotating wheels are used.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Bimetallic Brake Drums . . .

. . . with aluminum alloy metallurgically-bonded to cast iron, have better fade characteristics, better heat dissipation and deceleration properties.

Based on paper by **George T. Ladd**
Fairchild Engine & Airplane Corp.
and **Sydney B. Dew**
Wellworthy, Ltd.

SEVERAL English manufacturers are using aluminum alloy bimetallic brake drums with metallurgically bonded-in cast iron liners. The advantages of the aluminum alloy are principally its high thermal conductivity and light weight which results in better heat dissipation and improvement of unsprung weight.

Development of this type of drum has been along two major lines, designated as Mark I and II. In general, Mark I consists of a standard cast-iron or centrifused production drum with an aluminum muff or finned structure bonded to the outside surface, primarily to improve the thermal recovery of the drum by aircooling. This construction makes it possible to use available tooling. The aluminum can be pressure-die cast and bonded or permanent-mold cast and bonded to the iron drum in large quantities to save subsequent machining and keep the increased cost within reasonable limits.

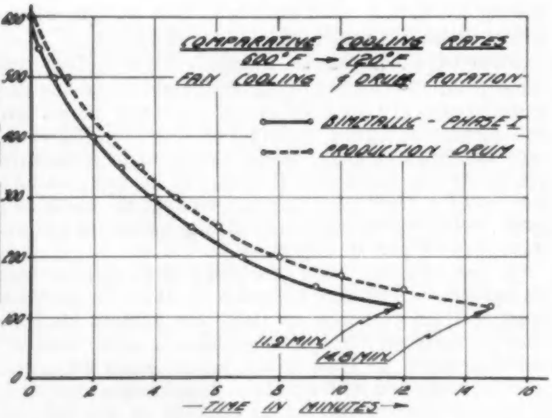


Fig. 1—Cooling curves for a standard cast iron drum and bimetallic drum indicate the faster cooling rate of the latter

The Mark II drum is an aluminum alloy housing which carries the torque and dissipates the heat, with a metallurgically-bonded cast-iron liner machined to the surface conditions required for braking use. Cast iron, having resistance to wear at high temperature, is used for the wear surface in combination with aluminum, having lightness and good heat conductivity, for the body of the drum.

Bimetallic drums have been made in the past with mechanical interlocks between housing and liner. However, the differences in coefficient of expansion of the metals tends to cause a separation of the aluminum from the iron band during heat cycling. With the bonded construction, relative motion of the interface is eliminated and the bimetallic unit will maintain original tightness and thermal conductivity.

Aluminum's ability to conduct heat rapidly from the hot contact surface is believed to be responsible, to a large extent, for the efficient operation of bimetallic drums, especially where optimum cooling by air convection is impossible. Unfortunately, the

amount of heat lost through convection during actual braking is negligible. Consider, for example, the case of an 18 ft/sec^2 stop from 60 mph, ideally requiring 4.6 sec to stop. Cooling curves (Fig. 1) for a standard iron drum and Mark I drum from a temperature of 600 F show the temperature loss during this interval is less than 20 F. This illustrates the great value of the property of fast recovery between stops, because it permits the drum to resume braking at a lower temperature level and not to rise to extreme temperatures with continued use. These curves also show the bimetallic drum returning to a temperature of 120 F approximately 19.5% faster than the standard drum. Temperatures of both drums were taken at a location 0.010 to 0.015 in. from the friction surface.

Tests of fade characteristics between an aluminum bimetallic circumferentially finned type drum and a standard cast iron drum (Fig. 2) indicate that at 392 F the former has the highest cooling rate. Similar tests with bimetallic drums on front and standard drums on rear indicate that the former require less pedal effort since they did not fade while the latter faded badly during the last half of the test.

Heat dissipation and deceleration properties of the finned drum are better than cast-iron drums when plotted with the same number of consecutive stops under similar conditions. Furthermore, bimetallic drums help considerably in elimination of squeal. Probably the ability to eliminate objectionable audio frequencies is due to the superior damping characteristics of aluminum as compared with cast iron. (Paper "Safe Brakes for Passenger Cars" was presented at SAE National Passenger Car, Body, and Materials Meeting, Detroit, March 3, 1953. It appeared in full in 1953 SAE Transactions. It is also available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members; 60¢ to nonmembers.)

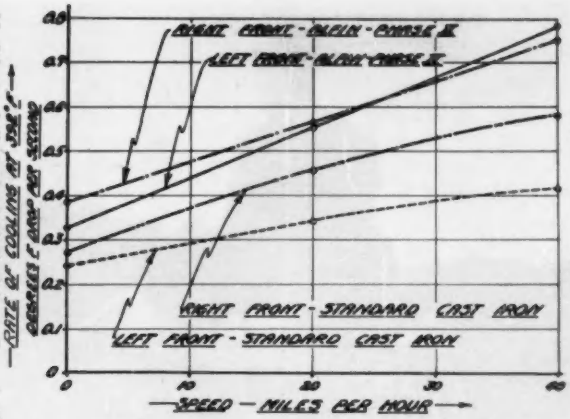


Fig. 2—Comparative tests run with a Riley 2½ liter car to determine relative fade characteristics of aluminum bimetallic circumferentially finned drum and standard cast iron drum. At 392 F the bimetallic drum showed highest cooling rate

Airfreight Users . . .

. . . ship small lots, expect frequent service to all their markets. That's why the passenger-cargo airline seems sure to gain much of the growing airfreight business.

Based on paper by **James M. Glod** American Airlines, Inc.

THE average airfreight shipment is small. American Airlines' average shipment in June 1953 weighed 213 lb. Average per piece was 36.5 lb. Of the 30,900 shipments, 91% weighed less than 500 lb. Two-thirds of the total tonnage came from shipments under 1000 lb.

Although shipments are small, shippers want service to all their markets. Shippers wouldn't be interested in a carrier who said, "I'll take traffic to ABC but not to XYZ." The shipper just won't gear his distribution to air speed to some markets and surface speed to others. He's almost sure to use the cheaper transportation for regular traffic and rely on air traffic for emergencies only. There isn't enough emergency business to keep an air carrier going.

Mixed passenger-cargo operations seem to be the answer to conveying small shipments on frequent flights to big cities and, in combination with short truck hauls, to little cities too. The passenger transports offer the capacity, the high-frequency service, and the speed desired. Constellations and DC-6's can carry 3000–6000 lb, depending on the configuration. American Airlines' DC-6B's, with upper cargo compartment, can take 10,000 lb of cargo. Most four-engine passenger aircraft can carry most of the traffic offered, on more frequent schedules, to more cities.

Of course, there are some large shipments—and they do justify operation of some all-cargo planes. About 5% of American's tonnage comes from shipments over 5000 lb. A few run up to 12,000 lb. Some shipments are too large for the passenger transports. Even with those that can be broken up and sent on two or three DC-6 flights, it's often better to load them on all-cargo planes to avoid split lots.

(Paper "The Passenger-Cargo Airline Approach to Airfreight" was presented at the Air Cargo Day session, Nov. 29, 1953, which was co-sponsored by SAE. It is available through the American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y. as Paper 53-A-236 at 50¢.)

Wheeled Tractors

WHEELED tractors have stolen some of the thunder of train locomotives and track-laying vehicles. Now all-wheel-drive, 4-wheel tractors can be equipped with laterally rigid wheels—a combination that permits taking advantage of the good drawbar-pull/weight ratio of crawler tractors. The steering problem has been licked! A special regenerative transmission that varies the relative speeds of the wheels on each side of the tractor (slowing down the inside wheels) proved the answer.

Before describing this steering mechanism, it should be mentioned that we felt a steering system for a laterally rigid 4-wheel tractor should possess these characteristics:

- The steering gear should not accelerate the outer wheels of the tractor, nor alter the effective overall gear ratio between the engine and these wheels.
- It should be fully regenerative. (The algebraic sum of the tractive efforts applied to the wheels on each side of the vehicle should be the same no matter what radius curve the machine may be following.) It must, therefore, employ no brakes for its control.
- It should drive the wheels on both sides of the vehicle at kinematic speeds, the ratio of which should correspond to the ratio of inner and outer radii of the curves followed by the inner and outer wheels respectively.
- It should contain no free differential so there will be no possibility of an unloaded wheel causing any of the other wheels to lose driving power.
- It should be simple, rugged, and have no excessively high-speed parts. It should as far as possible consist of spur gearing throughout which is highly efficient and easy to produce well. It should be relatively cheap to make, simple to install, and easy to service.

Now let's see how the Regenomatic measures up to these requirements. To do this, let us first analyze the mechanical layout of the Regenomatic transmission, then see how it works!

Fig. 1 shows a schematic diagram of this steering-transmission package.

The assembly in the lower half of the diagram is the input portion. It consists of forward and reverse bevel gears that are controlled by two clutches which engage one or the other. These bevel gears also serve as a means of disengaging the engine from the transmission (when both are free). The two spur gears shown on the bevel shaft are actually in mesh with the two spur gears shown in the upper half of the diagram, but they are separated here for the sake of clarity.

The Regenomatic transmission proper has three shafts. The upper or main shaft is broken by two clutches (marked "main clutches") which are normally fully engaged. The lower or steering shaft has on it a balance gear, two half-shafts, and a back-coupled drive from one side of the steering clutch to the casing or cage of the balanced gear. Both of these shafts terminate in pinions which are in constant mesh with a common final drive gear. (The pinions on the main shaft are larger than those on the steering shaft.)

Between the main and steering shafts is a pinion, mounted on a third shaft, which serves two purposes. It couples the shafts together in such a way that they run in the same direction and, in one gear range, it acts as the pinion through which power is transmitted to the wheels.

Make Like Crawlers

. . . All-wheel-drive 4-wheelers can now be equipped with laterally rigid wheels—giving them the good drawbar-pull/weight ratio of crawler tractors. The steering problem has been licked with a special regenerative transmission.

G. R. G. Gates, Managing Director, Gates and Hardy Limited

Based on paper "A Super-Regenerative Transmission for Multi-Driven Wheeled Tractors" presented at SAE National Tractor Meeting, Milwaukee, Sept. 15, 1953.

The shaft which carries this pinion is fitted with two dog clutches that permit any one of four gears to be driven by the shaft. (This combination of gears gives four speeds forward, four reverse, and two neutral.)

How It Works

The action of the Regenomatic is as follows.

As long as the vehicle proceeds in a straight line, the main clutches are locked in engagement and the steering clutch is disengaged. Under this condition, the wheels on each side of the machine are driven at the same speed.

When a turn is to be made, a control mechanism disengages one of the main clutches (depending on the desired direction) and progressively engages the steering clutch. Power to the outside wheels then proceeds uninterruptedly through the main clutch that remains engaged. With the steering clutch more or less engaged, the speed of the balance-gear cage tends to be reduced to that of the main shaft. At the same time the speed of the steering pinion on the same side of the machine as the disengaged main clutch is reduced even more. This, in turn, causes the inner wheels to be slowed down and the machine to turn in the desired direction.

Thus, in a turn, no change of kinematic ratio to the outer wheels takes place over that which exists when the vehicle is running straight ahead. The alteration in relative speeds is all at the inner or less powerful side of the vehicle. The action of the steering clutch is such that it progressively reduces the speed of the inside wheels until the machine is executing the tightest turn for which it is designed.

Its Engineering Features

Now let's consider the most important engineering features of Regenomatic.

One noteworthy feature is its ability to recover the negative or braking effort on the slowed-down side of the vehicle, transferring it as active propulsive energy to the faster moving side. This "bonus" energy not only supplies a very large portion of the power required to turn the vehicle, but also obviates wheel slippage—a common cause of power loss and rapid tire wear. For that matter, when the vehicle is running, for turns of less than two radians (and 90% of all steering comes within this category), the engine is not called upon to supply any extra power.

Another important property of Regenomatic hinges on the fact that the steering pinions are smaller than the main pinions. Thus, if both main clutches are disengaged and the steering clutch fully engaged, the drive to the wheels takes place through the steering shaft. This, in turn, gives a lower gear than that in which the machine is normally run, one which is extremely useful for starting a heavy machine under difficult conditions.

A third characteristic of Regenomatic is its

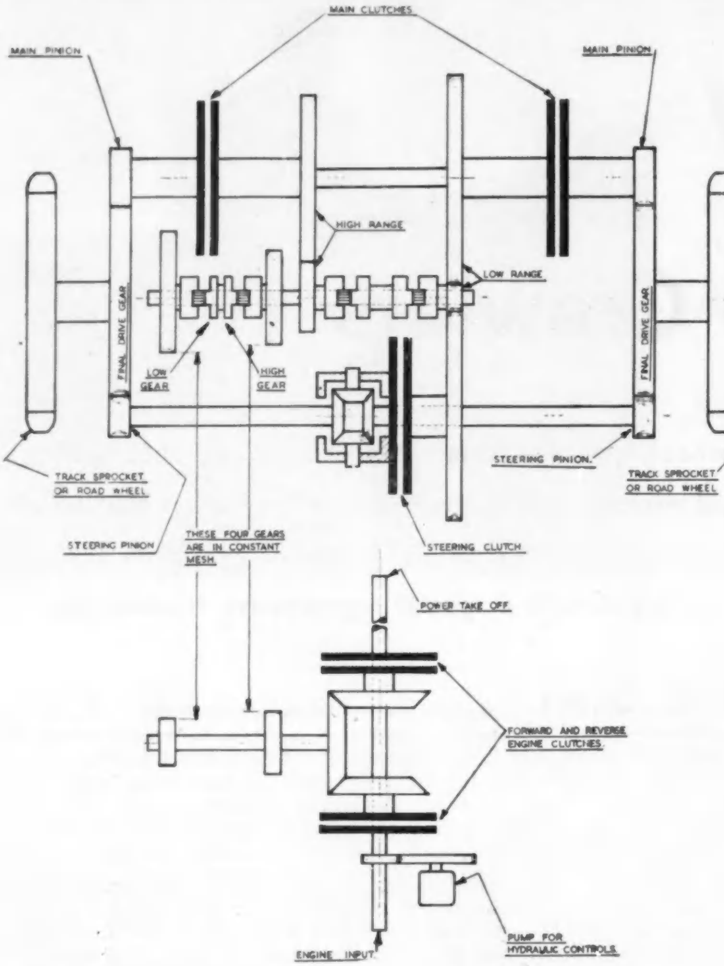


Fig. 1—Schematic diagram of Regenomatic transmission. This mechanism permits steering an all-wheel-drive 4-wheel tractor with laterally rigid wheels. It does this by slowing down the inner wheels on the inside part of the turn.

built-in parking brake. If the steering clutch is engaged with both main clutches disengaged, the entire mechanism locks up, thus providing an effective parking brake. For many applications, this type of parking brake is all that is necessary.

Regenomatic, too, can be equipped to permit a true pivot turn (one wherein one set of wheels is driven forward and the opposite set driven backward, both at the same speed). This is made possible by fitting the cage of the balance gear with a suitable brake or its equivalent. Then, using this brake (instead of the steering clutch) in conjunction with the main clutches, the operator of the vehicle can execute a true pivot turn.

A fifth advantage of this steering-transmission unit is the fact that there is no possibility of an unloaded wheel causing any of the other wheels to lose driving power. This is because the balance gear is always under the control of its associated gearing; it is never free.

(Paper on which this abridgment is based is available in full in multilithographed form from **SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)**

Excerpts from Discussion by . . .

H. W. Christenson
Allison Division GMC

NOVEL feature of Regenomatic is its geared steer mechanism. This permits reducing the speed of the wheels on the inside of a turn and regenerating the braking effort to help drive the outside wheels at the normal speed. Gearing down the inside wheels, without increasing the speed of the outside wheels, gives an overall reduction in ratio during steer. This is a basic advantage for mechanical gear trains since steer effort requires power, and reduction in ratio leaves more power available.

The Regenomatic reduces steer losses, too, but it does so by compromising turn rate ability. Actually, slip losses occur only during partial steer whether the system is a clutch-brake steer type or a geared steer control like the Regenomatic. With low-speed vehicles, most turns require full steer with the geared steer arrangement, whereas a large

percentage of turns made with a clutch-brake system call for partial steer. This would imply that the geared steer is superior in regard to power loss, however, in most applications of the Regenomatic, auxiliary brakes would be necessary to effect a sharp turn.

The Regenomatic does have the option of executing a pivot turn in neutral, but this is not wholly satisfactory. Shifting to neutral for sharp turns is not popular. And pivot turning where the inside wheels back over the towed load drawbar has little practical value. A set of auxiliary brakes mounted outside the Regenomatic main output clutches would be far more practical. Not only would they give auxiliary skid turn ability, but they could also serve as general-purpose service brakes.

The author implies that clutches give power regeneration, whereas brakes only waste power. However, International Harvester gets the same regeneration in a TD-24 transmission by applying disc brakes to planetary output gearing. When fully applied, these brakes give no slip power loss (similar to Regenomatic's steer clutch), and for partial turns, slip loss of Harvester brake and Regenomatic clutch is identical. Thus there is no power penalty due to the use of brakes. Also we believe that nonrotating friction members are simpler to control.

The author further states (in the paper) that the Regenomatic may be arranged to provide "every possible gradation of turn . . . from infinity down to that represented by a stopped (or even reversed) inner pair of wheels." As Regenomatic turns become sharper and approach clutch-brake action, the Regenomatic becomes no more efficient than a conventional clutch-brake system. Two machines which do identical things take the same power. In the extreme case of actually reversing the inside wheels, the Regenomatic would absorb more power than the clutch-brake system.

In conclusion, we believe that planetary arrangements are superior for heavy-duty equipment, but that Regenomatic may find some market interest in the field of small, light-duty machines.

Author's Closure

Mr. Christenson has fallen into the rather common error of confusing a geared steering system with one capable of giving true regeneration. Any steering system to be regenerative, whether epicyclic or any other type, must include means whereby the algebraic sign of the power to meet the steering effort at one side of the vehicle is changed from plus to minus.

In any multi-wheeled, multi-drive, laterally rigid vehicle, no matter what form of transmission is employed, the powers to meet the drag force at each side are defined (in unit time) by the following non-dimensional expressions:

$$\frac{Rs}{2Vi(1+2Rs)+2Rs}$$

for one set of wheels, and

$$\frac{Rs}{2Vi(1+2Rs)+2Rs+2}$$

for the wheels on the other side. Rs is the radius of the curved path which the locked inner wheels describe when dragged around by the outer wheels (dependent solely on the ratio of track width to wheelbase); Vi is the kinematic velocity of the inner wheels relative to the outer ones.

If, for example, we take a vehicle having a wheelbase equal to its track width, Rs will equal 0.45. If such a vehicle is made to execute a skid turn by locking the inner wheels to the frame, Vi will obviously equal zero and the power requirements will be 0.50 and 0.155, respectively. The sum of these is 0.655, or 65.5% of the power would be required to drag the vehicle in a straight line with all wheels locked.

Now if such a vehicle is fitted with geared steering so that the outer wheels turn twice while the inner wheels turn once, Vi becomes equal to 1.0 and the power requirements are 0.096 and 0.067, respectively. The sum of these, - 0.163 or 16.3% of the power required to drag the vehicle as above, shows the improvement in power requirement brought about by the less drastic turn.

If the vehicle is fitted with Regenomatic arranged to produce a similar kinematic ratio between the wheels on either side, while the individual power requirements remain the same, the regenerative action will reverse the sign of the lesser one. Thus the total power requirement will be the difference of the individual power needs, that is, 0.029 or 2.9% of the power that would be needed to drag the vehicle straight forward with all wheels locked.

It will thus be seen that under similar circumstances, *Regenomatic takes only 17.8% of the power taken by an equivalent geared steering system.*

If, for any reason, it were desirable to execute a skid turn on a vehicle fitted with Regenomatic, it would be quite unnecessary to fit wheel brakes, as Mr. Christenson suggests. It would only be a matter of selecting suitable main and steering pinion ratios to bring the wheels on the inside of the curve to rest. Under these circumstances, since the inner wheels would react against the transmission and not the frame, full regeneration would be maintained and the engine would be called upon to furnish only 34.5% of the power needed instead of the 65.5% for an ordinary clutch-and-brake skid steer.

The true pivot steer is an extremely useful feature, obtainable readily and cheaply on Regenomatic without detracting from any of its other good points. It is intended to be used only for maneuvering the vehicle in confined spaces at very low speeds, since, of course, no regeneration is possible. Nevertheless, it is not so extravagant in power demands as the clutch-and-brake skid steer; the figure for the vehicle cited being 47.3%.

Finally, it is difficult to follow by what line of reasoning Mr. Christenson arrives at the conclusion that Regenomatic is only suitable for small machines. Regenomatic is an exceedinly simple and rugged mechanism, is very easy to service, and contains no delicate parts running at excessively high speeds. It has been built successfully to handle powers ranging from 8 hp to 350 hp, operating at vehicle speeds from 1½ to over 40 mph. Surely it is only common sense that the bigger the job it is made to tackle, the more attractive become its manifest virtues.

Trucks Need

WHAT the trucking industry needs is transmissions that take fullest advantage of the engine's power and don't require three hands for shifting. Thanks to a cooperative project between truck operators and their suppliers, one such transmission is available.

The majority of current transmissions fall down on one or more of the following requisites for efficiently transferring horsepower with the proper ratio of torque for moving loads:

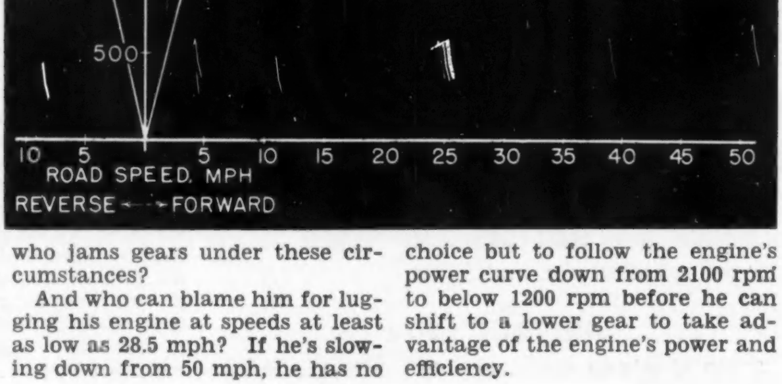
1. Selective gear ratios available with minimum effort and lost time during shifts.
2. Simple selection and determination of the next higher, or lower ratio.
3. Uniform gear increments.
4. Ratios close enough to prevent the necessity of "lugging" or overspeeding of the truck engine.
5. Ratios spaced far enough apart to provide a practical gain for each gear change.
6. Maximum overall gear reduction to provide torque up to the maximum of the truck's tractive ability.
7. Minimum gear reduction to provide desired top speed.

Figs. 1–3 show how typical transmissions fail to satisfy the above list of requirements. Fig. 4 shows the characteristics of an adequate transmission.

Here's an example of what happens with a four-speed, progressive, heavy-duty truck transmission when the driver tries to use the engine efficiently—that is, along the high-power, high-rpm segment of the power curve.

He starts off in low and runs the engine up to its governed speed of 2100 rpm, at which point the truck is rolling at 7 mph. To shift to second, he should disengage the clutch . . . take his foot off the accelerator . . . and, assuming truck speed has remained constant (which it seldom does), wait until engine speed drops to 1050 rpm, which happens to be the point corresponding to 7 mph on the second-gear curve.

This works if the truck doesn't decelerate too much while the engine speed is dropping. But on even a slight upgrade, the truck is likely to come to a stop before engine speed drops low enough to shift without jerking.



Who can blame the truck driver who jams gears under these circumstances?

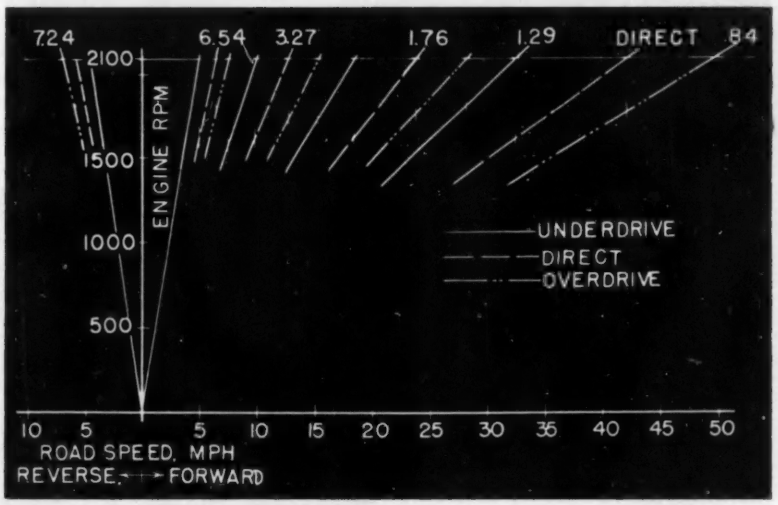
And who can blame him for lugging his engine at speeds at least as low as 28.5 mph? If he's slowing down from 50 mph, he has no choice but to follow the engine's power curve down from 2100 rpm to below 1200 rpm before he can shift to a lower gear to take advantage of the engine's power and efficiency.

Easier Shifting

Julius Gaussoin, President, Silver Eagle Co.

Based on paper "Gear Jammers—'Three Hands Cowboy'" presented at the SAE International West Coast Meeting, Vancouver, Aug. 19, 1953. (Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

One way to get around the necessity for lugging when decelerating from high speeds is to install a three-speed auxiliary transmission. Fig. 2 shows how with the combined transmissions, it is possible to decelerate from 50 to 30 mph, shifting from overdrive to direct to underdrive, without getting the engine down into its low-speed, low-power range.



But consider what happens as the truck is getting under way. The driver starts in underdrive-low. When the engine reaches governed speed, he shifts the auxiliary from underdrive to direct. The next shift, from direct-low to overdrive-low, is hardly worth making. Some operators instruct operators to make it; others forbid it. But the shift from direct-low to direct-second is too great to make, as explained with Fig. 1. So whether he goes into overdrive-low or not, the driver is soon faced with a double shift into underdrive-second. Here's where many transmissions are broken.

Assuming the driver did put the truck into overdrive-low, he should then double shift this way: He should decelerate the engine to about half governed speed, then shift the main transmission from low to second with one hand. With the other hand, he should shift the auxiliary transmission from overdrive past direct down to underdrive—and he should accomplish this with perfect coordination and proper sequencing of mind, muscle, engine, and transmissions. (Meanwhile, the driver should be steering with a third hand.) Obviously, even if the truck hasn't come to a stop, the double shift can't be accomplished on the road in this "ideal" fashion.

The driver has to be a gear-jammer. The trick is to get jamming over with in the shortest possible time.

It wouldn't be so difficult if the driver did have three hands. Since he doesn't, he must head the truck in the proper direction, take a deep breath, and push his stomach against the steering wheel. Then with a shift lever in each hand, he kicks the clutch, lets up on the accelerator, and jerks both transmissions into neutral. He waits a split second, kicks the clutch again, and simultaneously snaps the main transmission into second with his left hand and the auxiliary into underdrive with his right hand. (The training period is expensive.)

If he's strong enough and has done everything just right, this method will work many times before the mechanic or the boss ever finds out about it.

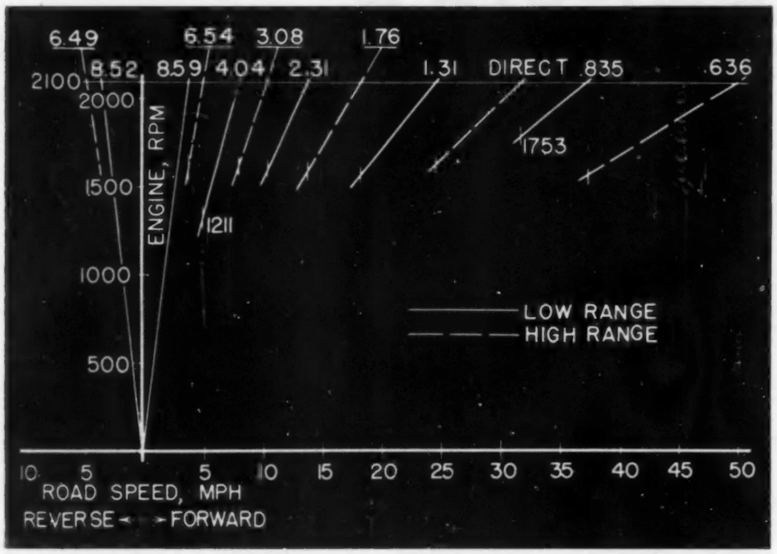
(Please turn page)

A slightly different approach to the problem of using engine power efficiently is the combination of a five-speed and a two-speed transmission, whose ratios are plotted here in Fig. 3.

Shifting is usually a little easier with this arrangement than with the four-speed, three-speed combination. The steps are more uniform and not so close together.

The five-two combination weighs about 100 lb more, but its design is simpler.

It offers gear ratios similar to those available with a five-speed transmission and a two-speed rear axle. The advantage of the dual transmission is that the ratio of sprung weight to unsprung weight is more favorable. Besides, if the transmission manufacturer furnishes both sets of gears, he has a better chance to provide good overall ratios than if he has to furnish a transmission to go with any of several rear-axle ratio combinations.



Of course, no one can say which transmission is best for a particular truck until he knows the characteristics of the power delivered to the transmission. Since air compressors, generators, fans, and other accessories absorb engine power, knowing brake horsepower is not enough. Transmission manufacturers, truck builders, and truck owners would be better off if we all got behind a truck horsepower ratings project.

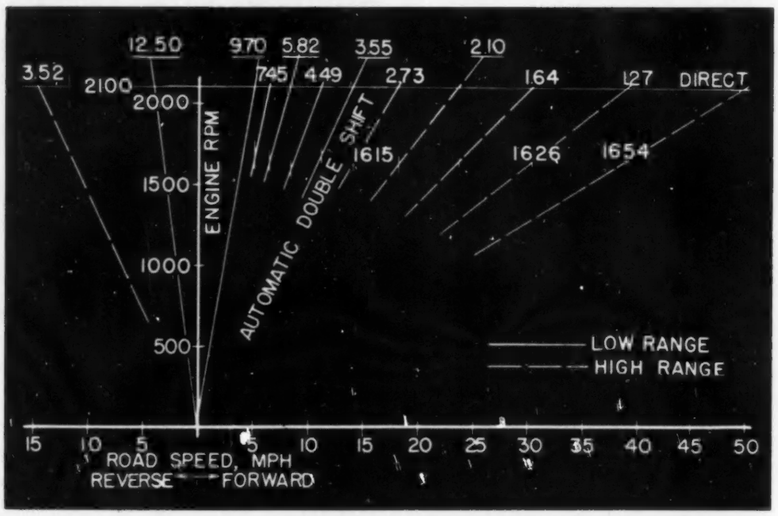
The net horsepower delivered to the wheels is all that is available to move the load. We believe there is a real need to know truck horsepower—not merely engine rated horsepower.

An example of the kind of transmission we need is the Road-Ranger, developed by Fuller Manufacturing as the result of truck horsepower rating studies carried out by the trucking industry.

This is a five-two transmission that can be shifted with one hand, yet it weighs no more than the four-three combination discussed.

The driver starts out in the low range in first gear and shifts his regular transmission in the normal progressive manner to second and on up to the top gear. Then he simply lifts a button on the shift lever and shifts to first-gear position again. From there he goes on up to fifth a second time.

Gear ratios were arranged for this transmission by an unusual method. As nearly as gear teeth permit, gear increments are uniform. The 27–30% increments make good use of the crest of the horsepower curve. Steps are not so close as to tempt the driver to shift out of a gear before the engine has reached maximum horsepower. Consequently the engine operates more of the time in the efficient high-speed, high-power range.



This transmission provides a very slow reverse desirable for truck and trailer operation around docks and in heavy going. It provides also a high-speed reverse which is useful in dump trucks or in tractors that have to back some distance to pick up their trailers. The range of available reverse speeds is much greater with this transmission than with the others discussed.

A continuation of truck horsepower rating studies should provide great incentive toward horsepower savings in operating accessories. What can be done? How much horsepower is lost? At what engine speed is the most horsepower delivered by the truck? There is great confusion now. More information is needed by fleet operators.

12 Volts Presents Its Case

Exhibit A:

Ignition improvement is offered as proof that 12 volts rates job in today's high-compression-engine passenger cars.

Other Exhibits:

Lighting, battery, starter, and generator don't bear this out.

S. M. Terry, American Bosch Corp.

Based on secretary's report of Round Table—12-Volt Versus 6-Volt Electrical System for Passenger Cars presented under the auspices of the SAE Passenger Car Activity at the SAE Summer Meeting, Atlantic City, June 10, 1953.

IGNITION improvement is the main reason for using 12-v electrical systems in certain of today's passenger cars, particularly the ones with high-compression, 8 cyl engines. As far as lighting, battery, starter and generator, and accessories are concerned, 12-v systems either are no better on the whole than 6-v systems or they are at a disadvantage.

The real measure of an ignition system is its ability to supply adequate secondary voltage to the spark plugs. And since spark-plug demand voltage is roughly proportional to engine compression ratio, today's high-compression engines are on the verge of taxing present 6-v systems beyond the limit of their abilities. For example, postwar 1946 engines of 6.4 to 1 compression ratio require 40 to 70% less ignition voltage than 1953 engines with 8.5 to 1 compression ratio.

Ignition Speaks Up for 12-v Systems

More demand voltage means that more energy is required from the ignition voltage source, but, unfortunately, present distributor contacts cannot handle any more current.

There are two ways to get this additional voltage and energy without increasing contact current: (1) use a 6-v, two breaker, 4-lobe cam distributor; (2) use a 12-v, single breaker, 8-lobe cam distributor. The second approach is considered by many to be the cheapest, simplest, and most practical way to do it. The greatly increased primary inductance thus obtained produces more secondary voltage and energy . . . and gives a slower rate of voltage decline with increasing cam and breaker speed.

Theoretically, the maximum expected life of distributor contacts will be less in a 12-v ignition system because the average primary current is higher. (With greater average current, contact transfer and erosion increases.) But since adoption of a 12-v system should decrease engine missing troubles, contacts will not be indiscriminately replaced at frequent intervals. Thus a much greater proportion of the useful contact life should be realized.

At the same time, a 12-v system should improve contact life in cold climates. Contact oxidation will be less during cold weather because the peak primary current in a 12-v system is lower than in a 6-v one. This is due to the fact that half of the primary circuit resistance in a 12-v system is in the form of a constant-temperature-coefficient resistor, rather than all in the copper primary winding.

Faster cold-weather starts, too, are possible with a 12-v ignition system. That's because the external primary resistor can be short-circuited, thus increasing the coil primary voltage over its normal cranking value. Take, for example, an engine that requires 16 kv to cold start it. At 10 v, with the resistor not shorted, the average available voltage is about the same as the average demand voltage, with peak requirements not being met. By shorting the external resistor, however, the available voltage is raised to 24 or 25 kv which more than meets the maximum requirement for cold starting.

Tests with a 12-v ignition system also indicate that it has adequate margin for 16,000 miles of operation. By contrast, a 6-v system is inadequate after 6000 miles, especially if it is part-throttle acceleration.

Finally, it is felt that a 12-v system will reduce

the problem of spark-plug fouling. That's because plug shunt resistance can be decreased to 0.6 megohm, as compared to a minimum of 2.3 megohm with a typical 6-v system. Thus, many engineers believe that a 12-v ignition system will be warmly welcomed by drivers who do a lot of slow-speed city driving.

Lighting Picture Not So Rosy

Insofar as passenger-car lighting is concerned, the scales seem to be tipped slightly in favor of a 6-v electrical system.

The optical properties of a 12- headlight bulb, for example, are poorer than for a 6-v one. This can be traced to the longer filament, larger light source in a 12-v bulb. The 6-v bulb filament can more nearly be located at the principal focus of the headlight parabolic reflector, hence the reflected beam is nearly parallel. In the case of the larger light source 12-v bulb, some spherical aberration takes place. Also for the same headlight wattage, the brightness per unit length of filament is lower with 12-v bulbs.

Satisfactory lighting can be achieved with 12-v bulbs, however, by stepping up the headlight wattage from 45/35 to 50/40.

As for relative cost, the normal complement of 12-v passenger-car light bulbs costs about 14% more than a comparable set of 6-v bulbs. This can be traced to the fact that filaments in 12-v bulbs are about twice as long and much more fragile than those in 6-v bulbs. Hence, it is necessary to use added filament supports in a 12-v bulb, and this naturally raises its cost.

The greater fragility of 12-v bulbs does not present any great problem except in such passenger-car applications as glove compartments, doors, and so forth.

Field Service Set Up for 6-v Batteries

The 12-v variety of storage battery not only costs more; it also presents a battery of field servicing problems.

A 12-v battery costs considerably more than a 6-v one because the same quantity of lead and other materials won't make as high an output battery in a 12-v rating. Add to this the fact that more battery power is required in present 12-v systems. Thus it is easy to see why 12-v batteries cost more.

Tooling for 12-v batteries presents a tremendous cost problem, too. Tooling costs run higher than for most other electrical-system accessories because of duplication of facilities. To make matters even worse, while only two types of 12-v passenger-car batteries are now available, this figure could easily go to eighteen.

As for field servicing, present systems are almost universally set up for 6-v batteries. Fast charging of a 12-v battery would have to be done by charging three cells at a time. Not only would this double the time required, but it would also enhance the opportunity for error in choosing the correct cell connectors, and so forth. Slow chargers now being used, it is true, generally can handle 12-v batteries as well as 6-v ones. But, unfortunately, there aren't enough 12-v rental batteries available.

Starters and Generators About on a Par

All of the three types of 12-v starting motors have advantages and disadvantages as compared with 6-v starters.

Consider, for example, a proportional-winding 12-v motor which has twice as many turns in its field and armature as its 6-v counterpart. As it is usual practice to supply a higher capacity battery for a 12-v system, line drop will be less . . . and a proportional-winding motor will give superior performance to a comparable 6-v one. It will, however, cost more than its counterpart because of the need for more insulation space, use of round armature wire instead of copper strap, greater labor expense with closed turn coils, and lack of mass-production tooling facilities.

Likewise, a 12-v starting motor designed around a 12-v field and a 6-v armature is better in some ways than a 6-v starter, worse in others. Performance-wise, it gives higher speeds throughout almost all of the useful torque range. But since power consumption is much greater than that of a 6-v starter, the possible cranking time is measurably reduced. On the plus side, it costs little if any more than a 6-v starting motor.

The third type of 12-v starter—standard type winding with more slots and smaller conductors—comes closest to being like its 6-v counterpart. It has comparable speed and torque up to 8 lb-ft, and requires only slightly more power. Cost is considerably higher than its 6-v counterpart.

Twelve-volt generators present an entirely different picture. For equal power output, a 12-v generator can be made smaller . . . or a generator the same size as a 6-v one can deliver peak output at appreciably lower speeds. (With regulator contact current as the limiting factor, more field excitation watts can be furnished a 12-v generator.) As for cost, the 12-v generator price is comparable to that of 6-v units.

Insofar as accessories are concerned, there is no great advantage to be gained with either system. Reduced cost of car wiring for the 12-v system is offset by higher cost of many of the electrical units.

Speaking For and Against 12 Volts

Panel members who expressed the opinions included in this article were:

C. W. Rainey, Panel Leader
Ford Motor Co.

S. M. Terry, Panel Secretary
American Bosch Corp.

L. E. Wells
Electric Storage Battery Co.

H. L. Hartzell
Delco-Remy Div., General Motors Corp.

C. R. Boothby
Electric Auto-Lite Co.

V. J. Roper
General Electric Co.

I. C. McKechnie
Chrysler Corp.

European Diesels

This article on European diesels is based on the following two papers and on written discussion of these papers:

Whither the European Automotive Diesel?

by P. H. Schweitzer, Pennsylvania State College;
and C. G. A. Rosen, Caterpillar Tractor Co.

Some High-Output Diesel Engines in Great Britain

by C. G. Williams and P. W. Bedale,
Shell Laboratories, England

Discussion by:

P. J. Carp, consulting engineer, Toronto, Canada
J. H. Pitchford, Ricardo & Co., Ltd.

These papers were presented at the SAE Summer Meeting, Atlantic City, June 11, 1953. The complete papers are available in multilithographed form from the SAE Special Publications Department. Price: 35¢ each to members, 60¢ each to nonmembers.

LOW consumption of inexpensive fuel has made the diesel engine very popular for automotive applications both in England and on the Continent. This popularity has encouraged designers to explore all possible means for attaining such desirable features as high output, reliability, low manufacturing and operating costs—and even better fuel economy.

Some designers have attempted to reach these goals by means of the 4-stroke engine; others, particularly on the Continent, have been developing very successful 2-stroke engines. The earliest engines of the latter type had uniflow scavenging. More recently, several 2-stroke loop-scavenged engines have made their appearance.

Along with these developments has been the increasing use of supercharging to attain higher outputs. In England, especially, supercharging seems to be favored over using higher rotational speeds to give the greater power output. Even the 2-stroke loop-scavenged engine is being supercharged with the aid of a rotary valve in the exhaust channel. It is claimed that this valve allows pressure charging without any sacrifice in the basic simplicity of the loop-scavenged engine.

Numerically, the long-entrenched 4-stroke diesel—especially the inline arrangement—still dominates the European automotive diesel field.

Moreover, many people seem to feel that it will continue to do so primarily because it has a lower specific fuel consumption than the 2-stroke engine. As Pitchford pointed out, one cannot at a *mean* load factor of 35% expect to have ones scavenging done for nothing, especially when a low-efficiency Roots blower is used in scavenging.

In addition, he explained, the 4-stroke engine is able to retain a cleaner exhaust in city bus operation, where there may be several stops per mile. When moving away under load after a 30–60-sec stop, the vehicle with the 2-stroke engine just doesn't have a sufficiently clean exhaust to be tolerated in England—or in France or Italy, either.

The British appear to be particularly exhaust conscious, for by law their engines are usually rated for automotive use within the limit of clear exhaust. The power output over the speed range is adjusted so that at no point is the exhaust visible. This emphasis on clean exhaust may explain why British vehicle diesels are all 4-stroke, with but one exception, the Foden.

On the Continent, however, an interest in the 2-stroke cycle goes back to the early '20's, when Junkers decided that it made no sense to have "as many scavenging pumps as one had cylinders" (as in the 4-stroke engine). He developed a 2-stroke, opposed-piston uniflow-scavenged diesel, which got into quantity production and reached the height of its development during World War II with the Jumo 205 turbosupercharged aircraft diesel engine.

Other 2-stroke, opposed-piston diesels were developed by the Swiss Sulzer and the French M.A.P. firms. There were also some attempts at sleeve-valve engines, but these failed to reach production, according to Schweitzer and Rosen. Finally, in 1948, following American lead, Foden introduced a poppet-exhaust-valve engine with uniflow scavenging. (See Fig. 1.) It was the first 2-stroke diesel to achieve commercial success in the European automotive field.

Meanwhile, others were working on loop scavenging. One of these was the German Schnürle, who developed the highly successful reversed-loop or back-flow scavenging system.

On the Continent interest in the loop-scavenged engine has become intense because of its great simplicity. Since ports are used for both intake and exhaust, there is no need for poppet valves, camshafts, pushrods, rocker arms, cylinder-head covers—or upper lubrication. This reduction in the number of moving parts simplifies manufacture and service and lowers friction horsepower. On the other hand, it was found that the engine that is by far the simplest mechanically has been the most complicated to design and develop, because of formidable gas-dynamic problems.

Its exponents persevered, however, producing such loop-scavenged engines as the Klöckner-Humboldt-Deutz aircraft diesel, the Krauss-Maffei, the Gräf & Stift in Germany, the Saurer in Switzerland, and the Atlas in Sweden. The only automotive one now in production is the Gräf & Stift (Fig. 2), which is being built in Vienna, Austria in 4- and 6-cyl sizes. The Atlas has enjoyed a long production record for industrial applications—driving air compressors. Schweitzer and Rosen consider it to be by far the simplest design of diesel engine, which illustrates the opportunities of the loop-scavenging

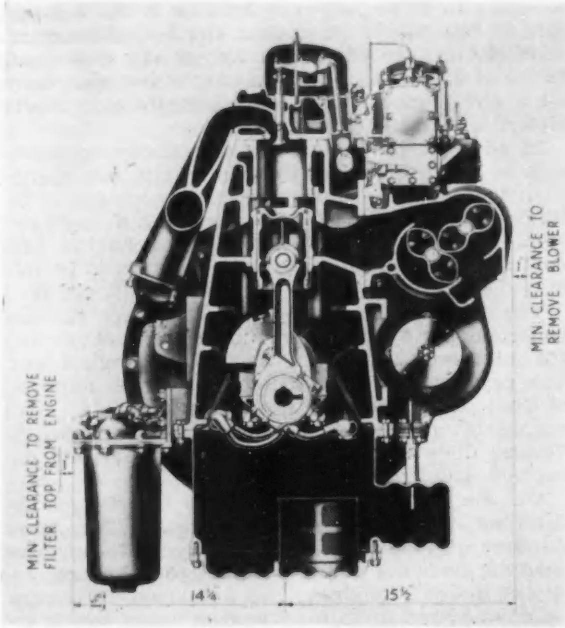


Fig. 1—Cross-section of 4-cyl version of British Foden 2-stroke engine. Bore: 3.35 in.; stroke: 4.73 in. Develops 85 bhp at 2000 rpm (from Schweitzer-Rosen)

system for low-cost manufacturing and ease of servicing.

In Europe the loop-scavenged engine is called the "poor man's engine" because its simplicity allows it to be sold at a low initial cost. It is also noted for its compactness—it gives most power in the smallest package, according to its friends.

The early 2-stroke engines had uniflow-scavenging because it was considered to be the most perfect scavenging system, theoretically, at least. This seems to be borne out by Fig. 3, which shows how scavenging efficiency varies with delivery ratio and with the scavenging arrangement. Schweitzer and Rosen suggested that cross-scavenging is the poorest because a considerable amount of shortcircuiting takes place, so that fresh air blows through the cylinder without driving out the residual gases. Uniflow-scavenging shows the best efficiency, and therefore the highest bmep.

With 140% delivery ratio—considered a good average for blower-scavenged engines—the bmep's are 58 psi for cross-scavenging, 75 psi for loop-scavenging, and 92 psi for uniflow-scavenging. Thus, the loop-scavenged engine would have a 20% lower bmep than the uniflow.

On the other hand, Carp claimed that, although mathematical analysis indicates uniflow-scavenging to be best, facts do not bear this out. We must not forget, he said, that mathematics cannot seize all the complicated phenomena; it must rely on many assumptions, some of which may not be entirely correct. He asserted that the Schnürle-scavenged engine has the best fuel economy, 5–10% better than the uniflow-scavenged engine for similar combustion processes, similar cylinder sizes, and similar rpm's and piston speeds.

He pointed out that the V4 Krauss-Maffei engine with centrifugal blower has a fuel consumption of 0.343 lb per bhp-hr and the V6 Gräf & Stift engine with Roots blower (Fig. 2) has a minimum consumption of 0.36. These figures can be compared with the 0.392 for the inline 6 Foden engine—the uniflow engine of best economy mentioned by Schweitzer and Rosen.

These and other performance figures show, Carp said, that the loop-scavenged engine has the highest efficiency. He stated that the loop-scavenged engine is able to give this high efficiency because the air is guided by the cylinder walls *around* the gases, which escape by their own pressure, by volume displacement, and by their inertia and gas-dynamic effects. The scavenging air in the uniflow engine, he explained, does not expell the gases in this pistonlike fashion. Rather, heavy mixing takes place, much more so than in the Schnürle process.

He suggested that this mixing of air and gases is the main reason for the very low exhaust gas temperatures mentioned by Schweitzer and Rosen for some of the uniflow-scavenged engines. This temperature is much lower than it should be, he pointed out, for the actual expansion ratio and heat losses encountered.

Moreover, he went so far as to assert that a good Schnürle-scavenged engine has a better efficiency than even the uncompounded 4-stroke engine, which has as many "scavenging pumps" as it has cylinders, and which also has to drive its valve mechanism.

He listed other advantages for the loop-scavenged engine as follows:

1. More freedom in designing the combustion chamber so the engine can digest efficiently a wide range of fuels.

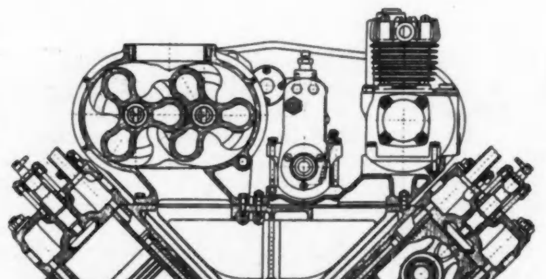


Fig. 2—Cross-section of German Gräf & Stift 2-stroke loop-scavenged engine. Bore: 4.73 in.; stroke: 5.51 in. Engine being built in 4-cyl and 6-cyl sizes. 6-cyl version is rated at 185 bhp at 2000 rpm (from Schweitzer-Rosen)

2. Larger and fewer cylinders, for the same weight and bulk, with a correspondingly better efficiency and softer combustion.

3. Better prospects for compounding (in comparison with the uniflow-scavenged valve engine) because of better impulse utilization and higher exhaust gas temperature, due to the reduced air dilution (better scavenging efficiency).

Pitchford said, on the other hand, that a serious disadvantage of the loop-scavenged system in high-speed engines is the fact that no organized air movement for fuel distribution can be superimposed on that required for scavenging without serious interference with the latter function. This state of affairs can be met, and then only to a limited extent, he continued, by the use of a 4- or even a 6-hole nozzle in an attempt to achieve acceptable fuel distribution at high speeds. This technique brings many service difficulties, he reported.

Thus, the answer to which type of engine is best is not clear at this time. One thing is certain, though, and that is that the 4-stroke engine, which had the field practically all to itself for many years, is being seriously challenged by the 2-stroke engine, particularly when it employs a loop-scavenging system of the Schnürle type.

Cost may be one good reason. For example, Schweitzer and Rosen reported that a certain 2-stroke loop-scavenged design was listed at a price only 60% of that of the conventional 4-stroke engine of the same horsepower and speed.

In Britain, there is some tendency to get higher specific output from 4-stroke engines simply by designing them to run at higher speeds. This is particularly true for the smaller vehicle engines. Recently, though, more and more designers have been going to supercharging to accomplish this result, Williams and Bedale reported, particularly for engines intended for heavy vehicles and earthmoving equipment.

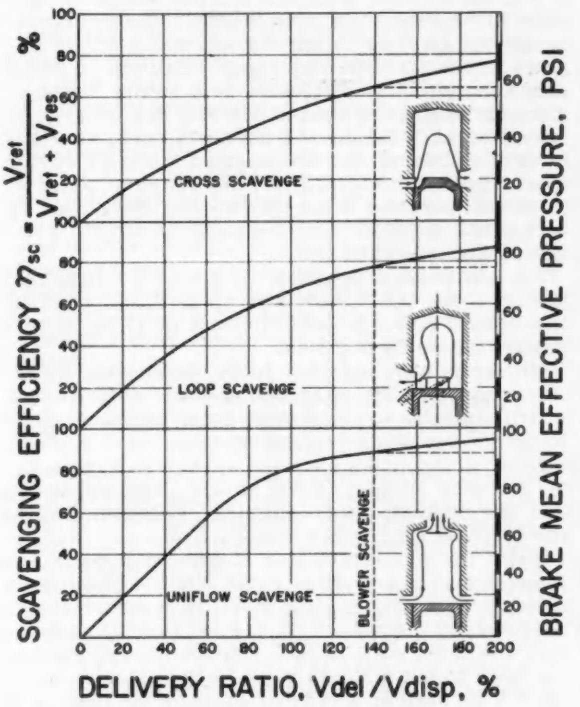


Fig. 3—Scavenging efficiencies of 2-stroke-cycle engines with cross-, loop-, and uniflow-scavenging (from Schweitzer-Rosen)

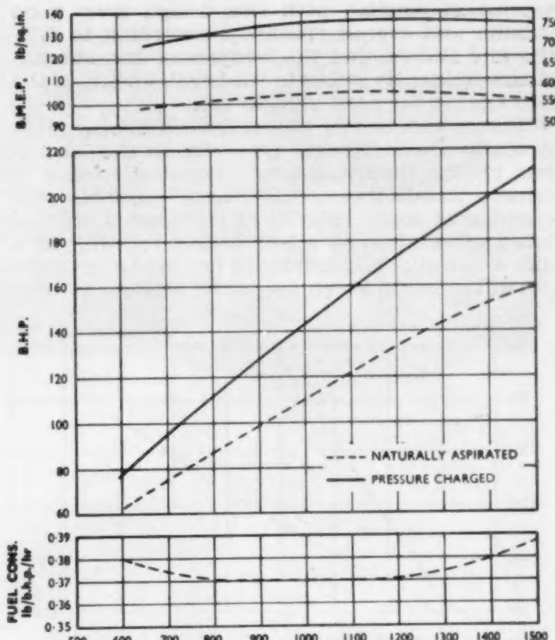


Fig. 4—Performance curves at automotive or 1-hr rating for British Dorman 6-cyl 4-stroke engine of 840 cu in. displacement. Supercharging with Roots blower (from Williams-Bedale)

For high-speed engines operating over a wide range of speeds and loads, the tendency to date has been to use mechanically driven positive-displacement blowers, such as the Roots (see Fig. 4), rather than the turbosupercharger.

Particularly for road vehicles, the mechanically driven blower has the advantage of giving instant response to the accelerator. This is not true of the exhaust-driven turbosupercharger, which must itself accelerate before it will satisfy the engine demand for increased air supply.

However, the Roots blower is by no means ideal, Williams and Bedale explained, on account of its large leakage path and inefficiency at low rpm. Better performance may well be achieved, they reported, with the use of the piston compressor advocated by Sir Harry Ricardo and now being developed by his firm.

This compressor has either one or two blocks of seven cylinders grouped axially around a single central rotary valve, which controls in turn both inlet to and delivery from both ends of each cylinder. The seven double-acting pistons in each block are reciprocated by means of a single nonrotating wobble plate mounted on a short Z crank. The pistons are entirely supported on long piston rods and do not touch the cylinder walls, so no lubrication is required inside the cylinder. The internal

compression possible with this design gives good adiabatic and overall efficiency, according to Williams and Bedale, and the compressor has characteristics eminently suited to the requirements of the diesel engine for road vehicle use.

Williams and Bedale also described another mechanically driven blower, developed in the laboratories of the British Internal-Combustion-Engine Research Association. This blower resembles the conventional Roots unit in that it has a pair of 2-lobed rotors geared together and rotating in a figure-8 casing. The difference lies in the arrangement of the ports, which are in the rotors, air being

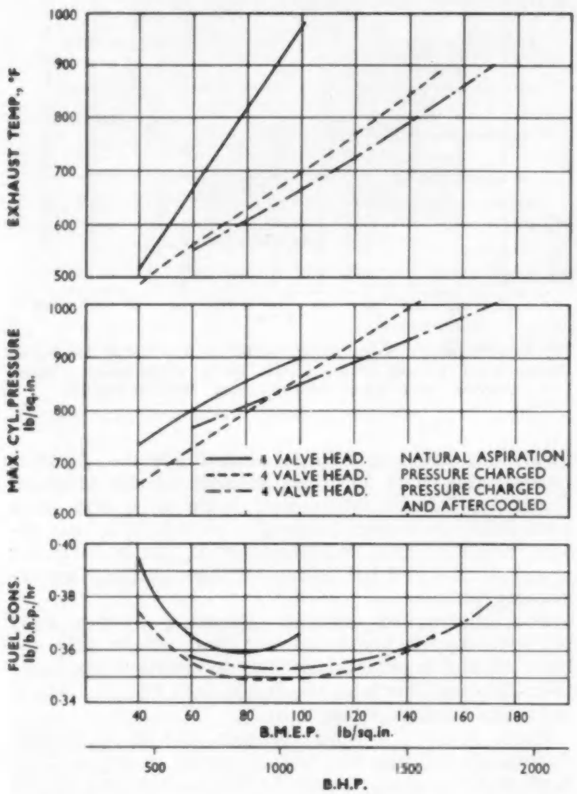


Fig. 5—Comparative performance curves at 750 rpm for British "English Electric" 12-cyl 4-stroke engine of 10-in. bore and 12-in. stroke (from Williams-Bedale)

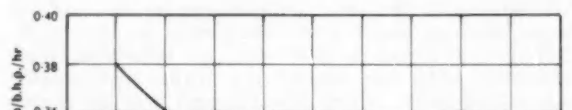


Fig. 6—Fuel consumption at 110 rpm for British Doxford 3-cyl 2-stroke marine engine. Turbosupercharger in series with reciprocating blower (from Williams-Bedale)

admitted through the center of one rotor and delivered through the center of the other. One advantage reported for this construction is that it allows internal compression, providing satisfactory performance up to 20 psi gage pressure. Another valuable feature is that by adjustment of ported sleeves inside the rotors, it is possible to alter the timing of the rotor ports while the compressor is in operation. The delivery characteristics of the unit can, therefore, be adjusted to suit the requirements of the engine while it is running.

Technically, Williams and Bedale contended, there are no insuperable difficulties in matching a turbosupercharger to high-speed engines operating over a wide range of speeds and loads, although it may not be easy to obtain optimum performance at all conditions. In so far as cost, simplicity, and bulk are concerned, however, they feel that the mechanically driven blower has the advantage, despite the higher mechanical losses involved.

In the medium-speed range the turbosupercharger is universally used for the higher rated engines, and in many cases the charge is cooled between the blower and the cylinders. The gains for one make of V12 engine that was aftercooled are shown in Fig. 5. It will be observed that a bmep of 170 psi was attained with a maximum cylinder pressure of 1000 psi and an exhaust temperature of 900 F, while at their present ratings these engines operate well below these figures.

In the early days of turbosupercharging only Brown-Boveri units of Swiss manufacture were available in England, but most British engine makers are now using the British-built Napier blowers either as alternatives or, in some cases, exclusively. These units range from the T.S.100, which is suitable for engines that have unblown power outputs of 220–360 bhp, up to the T.S.400, designed for engines in the 920–1600-bhp range unblown. A small supercharger—the T.S.90—is also under development for engines in the 140–220-bhp unblown range.

In general, Williams and Bedale claim an increase of 60% in output can be expected from an engine when supercharged at 5 psi, but for emergency or overload operation these blowers can deliver air up to 8½ psi, provided the designed maximum rotor speeds are not exceeded.

For continuous operation these speeds range from 9000 rpm for the T.S.400 size up to 21,000 rpm for the small T.S.90. A speed increase of 17.5% is permitted for up to one hour.

Napier is also reported to be developing turbosuperchargers with a higher pressure ratio to 2/1, which are expected to provide boost pressures up to 15 psi for continuous operation.

Supercharging is now being applied to some types of 2-stroke engines, such as the loop-scavenged and the opposed-piston engines. Compounding of the latter engine is also being tried.

Since the loop-scavenged engine with ports has symmetrical scavenging (with the exhaust port opening first and closing last), it is necessary to devise some method of closing off the exhaust before the inlet port closes. One successful method has been to put a rotary valve in the exhaust channel. This system was tried as early as 1924 by a Berlin firm on a cross-scavenged 3-cyl gasoline engine. It is being used on the Swiss Saurer, which

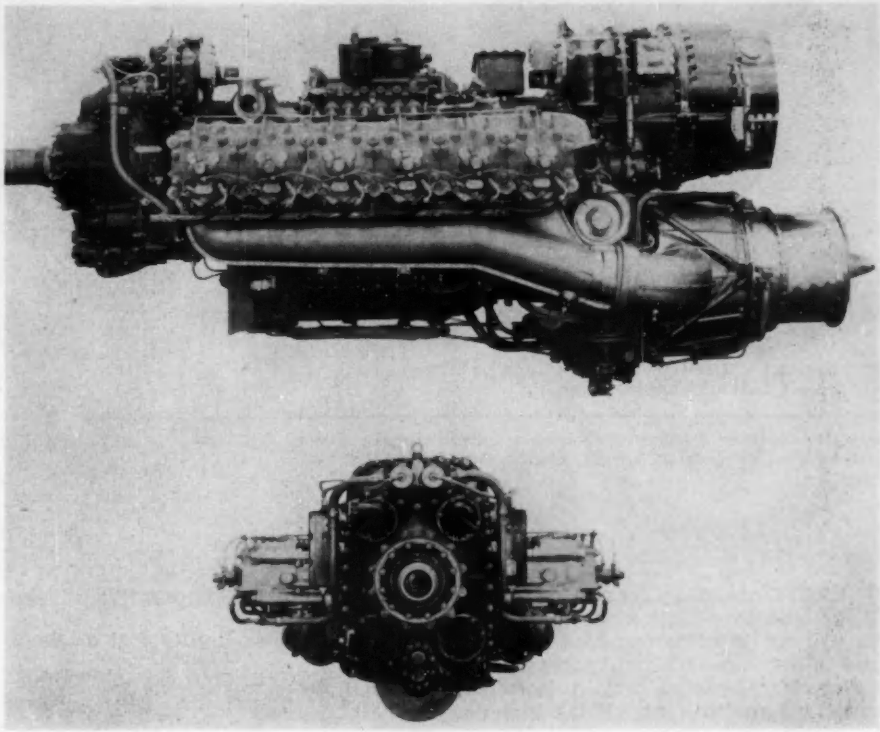


Fig. 7—British Napier "Nomad" compound engine. 2-stroke diesel engine combined with turbine-compressor set to give 3135 equivalent hp (from Williams-Bedale)

is a very promising loop-scavenged diesel engine still under development, according to Schweitzer and Rosen.

The rotary valve is simple and reliable. It is just a tube, with suitable ports, running at engine speed in the exhaust passage. It operates with a clearance since it only seals against scavenging pressure, and air losses are too small to matter, according to Carp. Unlike poppet valves, the rotary valve does not introduce inertia forces that, he pointed out, have the effect of limiting engine speed.

William Doxford & Sons, Ltd., have also investigated supercharging for their 2-stroke opposed-piston marine engines. Preliminary tests have been made on a 3-cyl engine having a bore of 23.6 in. and a combined stroke of 78.8 in. The standard engine has a reciprocating scavenge pump and three arrangements have been tried with the turbosupercharger:

1. In parallel with the reciprocating blower.
2. In series with the reciprocating blower.
3. With the turbosupercharger alone.

These tests showed that the series arrangement was best. The parallel arrangement gave a considerable interaction between the irregular delivery of the reciprocating blower and the uniform supply of the centrifugal unit.

There was insufficient energy in the exhaust to ensure a really adequate air delivery for the turbosupercharger to be used alone. As a result, when this was tried the exhaust was slightly smoky, although the engine could be started and run at quite low speeds.

The fuel consumption curve for the series arrangement is given in Fig. 6. It shows that at an imep of 100 psi the specific fuel consumption was 0.325 lb per bhp-hr and at full load it was less than 0.34 lb per bhp-hr. Specific fuel consumptions as low as this are not, however, unusual, according to Williams and Bedale, even in naturally aspirated engines of this size. The results of these experiments show, they claim, that a 6-cyl engine having a bore of 29.5 in. and a combined stroke of 98.5 in. would, when fitted with a turbosupercharger, deliver 13,000 bhp at 110 rpm.

A natural development from turbosupercharging is the compound engine; that is, some of the power recovered from the exhaust is fed back to the crankshaft. Napier now has such an engine under development. This engine, the Nomad, consists of a simple valveless 2-stroke engine to which has been added a turbine-compressor unit. The axial-flow compressor is on a common shaft with the multistage exhaust turbine, and the turbine-compressor set thus formed is coupled mechanically to the engine through suitable gearing. The power of the engine and the surplus power available from the exhaust gas turbine are transmitted to a common, single-rotation propeller shaft by a reduction gear in the nose of the engine assembly. The Nomad is controlled by a single pilot's lever.

As shown in Fig. 7, the engine has two 6-cyl blocks of horizontally opposed cylinders. The weight of the complete engine is 3580 lb for an output of 3135 equivalent horsepower. The specific fuel consumption is 0.33–0.35 lb per ehp-hr over a wide range of speeds and altitudes. The low fuel consumption is achieved by the use of a high compression ratio and a high expansion ratio, which are made possible by the combination of a diesel engine with a gas turbine.

Better Deal Ahead

F. R. Nail, Mack Mfg. Corp.

Excerpts from paper "Methods of Overcoming Inherent Disadvantages of COE" presented at the SAE National Transportation Meeting, Chicago, Nov. 4, 1953.

CREATED originally for service in congested traffic, the cab-over-engine tractor has undergone intensive modification to adapt it to highway service and to overcome inherent difficulties.

During this period, certain shortcomings have inevitably come to light. These include:

1. Harder riding characteristics than in the conventional tractor.

2. Driver discomfort from fumes, engine heat, and noise.

3. Comparatively inaccessible powerplant.

4. Higher cost of sheet-metal maintenance.

5. Controls—including steering wheel, pedals, gearshift lever or levers, and hand brake—that are complicated and inconvenient.

Based on past experience, the preferred methods of overcoming the inherent disadvantages of cab-over-engine tractor construction are:

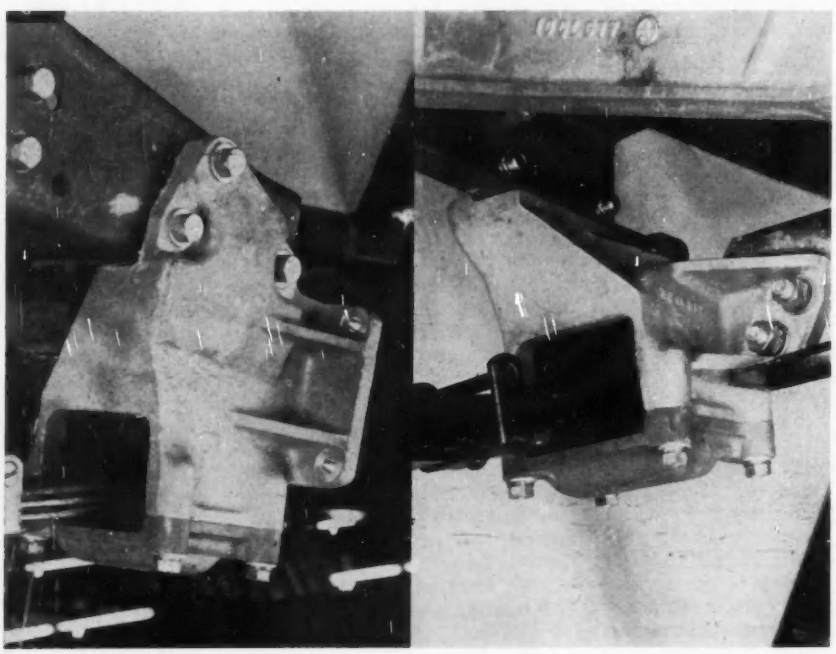


Fig. 1—Multipurpose front bracket in which functions of spring hangars, front cross-member anchorage, and bumper support have been combined

for COE Drivers

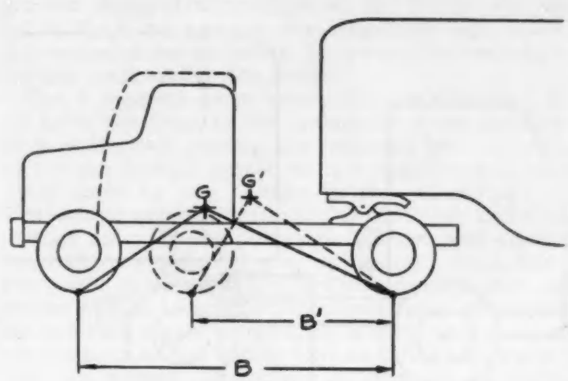


Fig. 2—Wheelbase of conventional tractor compared with wheelbase of cab-over-engine tractor

1. For the alleviation of hard riding characteristics:
   a. Modification of existing combination designs to permit longer wheelbases within the same overall combination lengths.
   b. Control spring flexibilities to position center of oscillation at or behind the rear axle.
   c. Cushioning of fifth-wheel impacts.
2. To improve sealing and insulation:
   a. Elimination of openings through the use of tilting or elevating cabs.
   b. Sealing necessary openings through the use of positive pressure closures.
   c. Design of control lever geometry so that bellows-type boots may afford hermetic sealing.
   d. Designing for utilization of flat floors and dash sheets, thus reducing the sealing problem.
3. To improve accessibility:
   a. Provision of tilting or elevating cabs.
   b. Elimination of necessity of removal of panels, relying on fixed hinges where openings are mandatory.
4. To reduce sheet-metal maintenance:
   a. Unitize construction to eliminate fight between associated parts.
   b. Elimination of large flat areas.
   c. Cab framing design to conform to shape of the supported surfaces.
   d. Improve riding qualities.
5. To improve controls:
   a. Design for driver comfort and safety rather than for ease of production in numerous ways now exemplified in current production.

. . . And here are the detailed facts on how hard riding characteristics and driver discomfort are being overcome:

HARD riding will be discussed first because it seems to be most fundamental as regards its causes and to call for the most basic engineering approach to a solution. We are here concerned, of course, only with that species of hard riding which is peculiar to COE tractors as distinguished from those of the conventional type, or COE 6-wheelers. The difference in their behavior arises from the difference in wheelbase length, rather than the relative locations of the cab and engine. Conventional tractors with front axles set back under the cabs behave in much the same manner as 4-wheeled COE tractors; while 6-wheeled COE's often provide a better ride than conventional types of equivalent wheelbase.

Tractors of both long and short wheelbase have

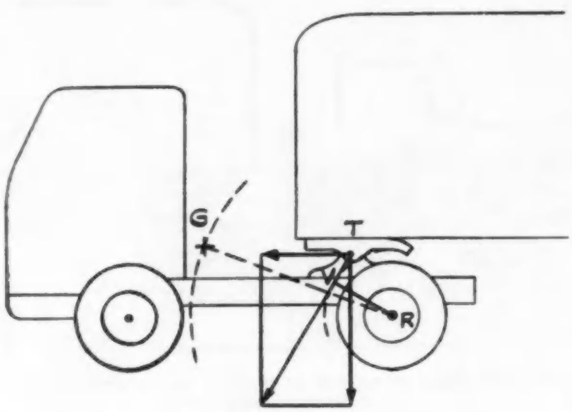


Fig. 3—Center of oscillation at rear axle

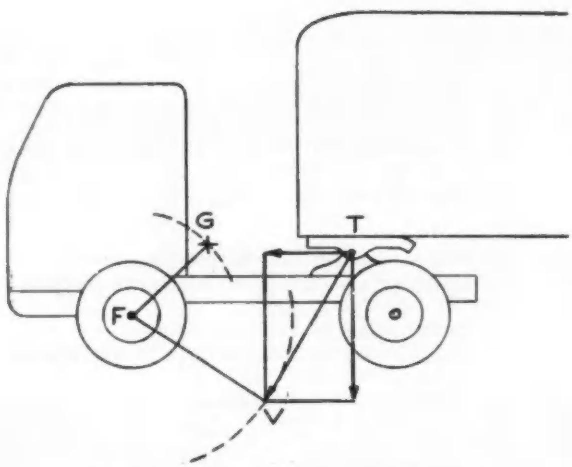


Fig. 4—Center of oscillation at front axle

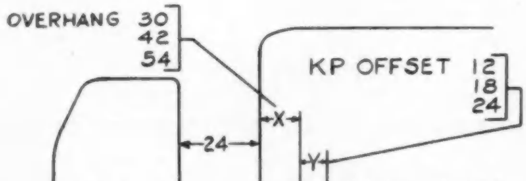


Fig. 5—Longer wheelbase possibilities

to contend with a somewhat greater range of imposed load than straight trucks because, besides operation with an empty trailer, they also operate to some extent "bobtailed," that is, disconnected from the trailer. In this respect there is far less difference between conventional and COE types than there is between 4-wheeled and 6-wheeled forms, the latter providing an inherently better ride in either type.

We are not greatly concerned at the moment with the ordinary vertical oscillations induced by road irregularities, which are common to all wheeled vehicles. To be sure, length of wheelbase has some effect, since the longer the wheelbase the less the center of gravity tends to be displaced by a given displacement of a wheel. Likewise, the height of the center of gravity affects sidesway and pitching resulting from successive passage of the axles over a given obstruction.

However, current COE design does complicate some of the obvious solutions to this problem. If the front axle be placed as far forward as possible within minimum overall length limits, it is difficult to provide as much front spring length as might be desired for the sake of low frequency under high deflections within reasonable limits of fiber stress.

High static deflection and thin leaves, asymmetric proportioning, and multipurpose front brackets all offer means of obtaining the desired characteristics within the limited space available. Fig. 1 illustrates a multipurpose front bracket in which functions of spring hangars, front cross-member anchorage, and bumper support have been combined.

With the axle set back, ample space for long front springs is afforded; but there is the penalty of a shorter-than-ever wheelbase. This may cancel out the anticipated gain.

Our chief problem is concerned with longitudinal oscillatory forces on the fifth wheel due to variations in tractive resistance of the trailer in negotiating uneven road surfaces and to its inertia in accelerating and decelerating. These seem to produce the greatest difference in effects on the two types. This is because of the effect of wheelbase on longitudinal stability, as shown in Fig. 2.

Obviously, because of the shorter wheelbase (*B'*) and higher center of gravity (*G'*) of the COE, both the horizontal and vertical components of the force from the trailer, acting on the fifth-wheel trunnion, will induce a greater tendency to pitching in the COE than in the conventional type. Because the driver is seated higher, the effects of this pitching on him will be somewhat intensified in the COE.

This pitching is not necessarily about the center of gravity. Rather it will be about a center of oscillation, whose location is determined by several factors, such as the relationship of the fifth-wheel trunnion, at which the longitudinal forces are applied to the center of gravity, the front axle and the rear axle, respectively, and the deflection rate of the springs individually and relatively.

Were there no springs and disregarding tire deflection, pitching would not result. It is, therefore, the deflection of the springs and to a small extent that of the tires, due to the rapid longitudinal transfer of weight forward and backward, which results in pitching. Were there no springs at the rear, as in Fig. 3, the center of oscillation would be

at the rear axle. The trailer load applied at the fifth-wheel trunnion *T* would then have a moment about this center of *V-R*. The deflection of the front springs would produce a predominantly vertical oscillation of the tractor, which, owing to the relatively high polar moment of inertia (*R-G*), would tend to be of low frequency.

Conversely, if it were the front axle that was without springs, as in Fig. 4, the center of oscillation would be the front axle, the moment from the force from trunnion *T* would then be *F-V*, considerably greater than that in the previous case, while the polar moment of inertia (*F-G*) would be reduced, the two combining to produce reactions of greater intensity and higher frequency. Also, with only the rear springs deflecting, the oscillation would be mainly horizontal.

In the first instance, the effect of variations in trailer thrust upon the driver would be comparatively slow up-and-down jouncing, while the second would produce violent pitching or as it is commonly termed, neck-snapping. Of the two effects, that represented in Fig. 3 is much to be preferred, as the discomfort resulting is of a less objectionable kind and can be somewhat ameliorated by increasing the effectiveness of front shock absorbers and seat cushioning.

With springs effective both front and rear, the effect of fore-and-aft thrust on the fifth-wheel trunnion is somewhere between these extremes, depending upon the relative stiffness of the springs.

From this it would appear that the pitching effect would be somewhat reduced by making the front springs relatively more flexible than the rear ones. This is the usual situation when the trailer is without load, but the reverse can be the case with a full payload.

Variable-rate rear springing would appear to offer advantages, therefore, since the resilience at the rear end can be maintained throughout the range of loading and be kept relatively stiff at all loads. Undoubtedly, there is also need for front shock absorbers of a character which, while functioning normally with respect to road shocks, would offer greater effectiveness against pitching. Perhaps a combination of air and hydraulic action, as in airplane shock absorbers, would offer possibilities.

Attempts to alleviate the hard riding of some COE tractors by specially sprung seats, equipped with shock absorbers, have not been entirely successful, as these do not take care of the fore-and-aft motion.

Another approach might be to attempt suppression of the fore-and-aft forces by some form of controlled cushioning of the fifth wheel, whereby it would absorb these oscillations, converting their energy into heat. No work along this line seems to have been done, although draft springs on fifth-wheel mounts have been tried with questionable success. Certainly, such a shock suppressor would involve an elastic element, such as springs, rubber, or air and a damping element which might be of the friction, hydraulic, or viscous type.

Since wheelbase plays so large a part in the effect of trailer inertia on ride, it might be well to reexamine our reasons for the extremely short wheelbases common on COE tractors. Of course, as we foreshorten the front end of the tractor, leaving the rear end alone, we achieve a shorter wheelbase. And if, in addition, in the effort to concentrate a greater share of the weight on the front axle, we set it back, we shorten the wheelbase still more. But suppose we endeavor to move the rear axle further back under the trailer?

Fig. 5 suggests some interesting possibilities. If we leave the front of the trailer the same distance back of the cab, moving the rear axle back will not affect the overall length of the combination, nor need there be any change in the percentage of fifth-wheel weight distributed to the front and rear tractor axles, if the fifth-wheel offset and trailer overhang are adjusted proportionately. This, however, will certainly require some modification of trailer design, including increased throat clearance for the rear end of the tractor and an alteration in the position of the trailer axle or tandem to maintain the proper proportion of load on the fifth wheel.

Three rear-axle positions are shown in the sketch, namely, the conventional, an extreme rear position, and a compromise in between. In each case,

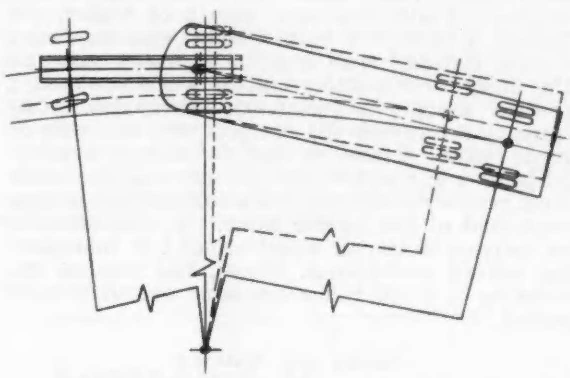


Fig. 6—Direct geometrical comparison between two combinations, each of the same overall length and with the same length of trailer. One has, however, a relatively long tractor wheelbase and shorter distance from kingpin to trailer axle and the other has a shorter tractor wheelbase and a greater kingpin-to-trailer-axle dimension

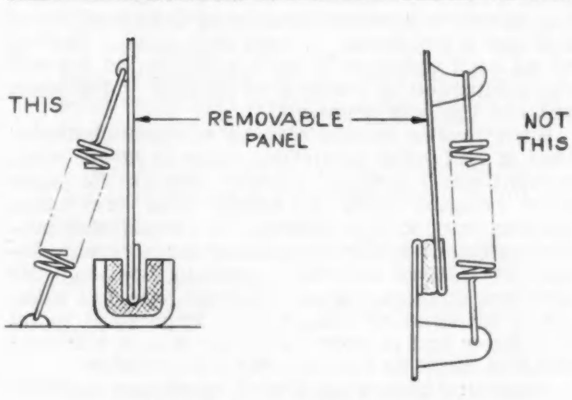


Fig. 7—Types of closure seals

the fifth-wheel load is distributed in the same proportion to the tractor axles. Obviously, in the extreme case, it would be difficult to position the landing gear close enough to the front to support the detached trailer safely; and the proper load distribution on the trailer would require the trailer axle or tandem to be placed so far forward that the total axle spread would occasion a serious decrease in bridge formula gross weight allowance.

However, a moderate increase in tractor wheelbase, both by positioning the front axle as far forward as possible and by a conservative shifting of the rear-axle backward, while it cannot completely solve the problem, may contribute materially toward solution in connection with other modifications.

Despite the popular belief that a short tractor wheelbase ensures a smaller turning radius, the facts are that the tractor wheelbase has very little effect upon how sharp a curve or corner the combination may turn. While it is true that the tractor itself will have a shorter turning radius, other things being equal, that of the complete combination depends more upon the distance from the kingpin to the trailer axle.

Fig. 6 shows a direct geometrical comparison between two combinations, each of the same overall length and with the same length of trailer, one having a relatively long tractor wheelbase and shorter distance from kingpin to trailer axle and the other with a short tractor wheelbase and a greater kingpin-to-trailer-axle dimension. Offtracking determines the sharpest turn that may be made within a lane on the highway or between curbs on a city street, and in every case the minimum practicable turning radius is materially greater than that of the tractor alone. In this example, an increase in tractor wheelbase of 1 ft, maintaining overall combination length, has reduced offtracking by 1 1/3 ft for the same overall turning radius.

Sealing and Insulation

Driver health is being given the consideration it deserves in the development of COE designs. The problem is more difficult than with conventional types both because the cab is located directly above the powerplant and also because the tendency to have numerous openings to the powerplant within the cab offers increased liability of leakage of fumes and the transmission of heat and sound. Sealing of all such openings in such a way as to prevent the infiltration of fumes is of primary importance, but not the sole necessity.

Such sealing should also be of such character that it will have insulating value in itself, shall prevent metal-to-metal contact between the parts, thus reducing heat conduction and preventing squeaks, rattles, and buzzing. It should also provide sufficient resiliency to allow for a certain degree of relative movement without breaking the seal and, of course, be of materials that will withstand extremes of temperature, impervious to oil and water and of such durability that it will continue to fulfill its function for a long time.

Sheathing of insulation with impervious material or coating has been found necessary to prevent its becoming oil-soaked. Oil-soaked insulating material not only loses some of its insulating properties, but it eventually emits an offensive stench and, worst of all, constitutes a fire hazard.

Obviously, the fewer openings there are between the cab interior and the powerplant compartment, the better. For the unavoidable openings much can be done to render the seals more effective by arranging the positions of such things as hinges and latches so as to effect direct pressure closure, without sliding or scrubbing contact, and to distribute the pressure as evenly as possible. It is also important that the sealing material be securely anchored to prevent peeling out. (See Fig. 7.)

Common sources of fume leakage, as well as both hot and cold air, are the pedal and lever slots in the toe- and floorboards. The ordinary split-rubber membrane neither serves long nor well, while sliding dampers are difficult to design so that they will work smoothly without binding, in addition to which they are expensive to make and to maintain. The usual stop muff on pedal levers is effective, if at all, only when the pedal is released and rarely is or can be adjusted to compensate for changes in pedal throw with the wearing of the clutch. Modern air brake treadle valves are perhaps least troublesome in this regard.

It would seem worth while to design pedal levers in such a way that the angularity of the strut portion would be compatible both with the arc of pedal lever travel and the angularity of the toeboard. The suspended type of pedal could be developed so that it would offer a complete solution, but there are many who object to the inverted arc of travel.

Where a gearshift-lever tower projects through the floor, a simple seal is easy to provide; but when, as usually is the case in COE construction, the lever projects through a long slot in the floor, the problem is difficult. One solution which seems to meet all requirements for such levers and could be adapted to the clutch pedal is the flexible bellows type of boot, affording virtually hermetic sealing.

Perhaps an ideal solution of the gearshift problem would be the adoption of steering column control, which is universal in passenger cars; but this must probably await the general adoption of powershifted or automatic transmissions.

Insulation, like sealing, is made more difficult because of the sometimes intricate formation of the bottom and front of the cab and the introduction of numerous doors, plates, and hatches. Construction in which the floor and dash are flat or, if a scuttle is necessary, it is made to provide clearance only and not to be opened, as in the case of tilting cabs, presents the simplest situation, since every opening must, of necessity, require a break in the insulation around its edge.

A point often overlooked is the necessity of insulating under the seat as well as under the floor- and toeboards and on the dash. This is particularly true of those types in which the engine is placed beneath the seat, with a drop floor in front of it. One manufacturer insulates under and back of the seat by means of a flat air duct, drawing outside air in through a screen on the side of the cab, through the duct, and to the radiator by fan suction.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

A Good Maintenance Plan Can't Rest on Its Laurels

E. C. Paige and H. T. Mueller, Ethyl Corp.

Based on paper "The Three E's of Operation and Maintenance—Engineering, Equipment, and Education" presented at SAE International West Coast Meeting, Vancouver, Aug. 19, 1953.

NO good maintenance plan can remain static. Administration must be constantly on the alert to apply new tools, methods, designs, and materials. With this in mind, it's important to broaden general knowledge of:

1. What is available?
2. Where can it be applied?
3. Is it worth the price?

Many excellent sources of information are available to help answer these important questions. Unfortunately, some are overlooked entirely; others are not used to full advantage.

Certainly the service and engineering groups of vehicle, equipment, accessory, fuel, and lubricant suppliers should be consulted. And the various trade and technical publications subscribed to by many fleets should be put to greater use. Much more of their potential value would be realized if a planned reading, indexing, and discussion system were employed for key supervisory personnel in administrative and mechanical departments.

As for point number three, it should be noted that the term "price" has been used instead of "cost." These are two entirely different things. The immediate outlay of cash for an item represents the price, whereas the extent of its performance or utility determines its ultimate cost. For example, it has been demonstrated that such engine components as chrome-plated piston rings and sodium-cooled exhaust valves have extended service life so much that despite higher initial price, the ultimate cost per mile has been drastically reduced.

The same evaluation is fundamental with respect to purchase of shop equipment and education of personnel on how to use it properly.

There is an important item in connection with tools and equipment which has been found to be lacking in many maintenance shops. It is the matter of suitable gages or fixtures with which to check the precision of work performed. These are shop musts today because today's precision-built engine and chassis components require precision adjustments and accurate fits to maintain their high degree of performance. And neither a mechanic nor his tools can be expected to perform continuously at a high standard of exactness without some form of inspection or control. It is, therefore, of prime importance that the quality of the job be measured or checked by appropriate instruments if the maximum return at minimum cost is to be achieved.

Actually many instruments are available for this —both new and old. It behooves fleet operators to evaluate them in terms of their particular shops, taking into consideration the three questions outlined at the beginning of this article.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Keeping Abreast of 1960 Truck Engines

Knowing what is available in the way of truck engines is another good rule for fleet operators. Thus they will be interested in knowing that powerplants for 1960 trucks are expected to have greater specific outputs, use less fuel per bhp, and have durability equal to or better than that of today's best designs. It is probable they will have:

- $\frac{1}{2}$ bhp per cu. in. of displacement for gasoline engines and 0.4 bhp per cu. in. for diesels.
- Compression ratios of 7.5 or higher (gasoline engines).
- Up to 20% better fuel economy (diesels).
- Lower weight—both on a lb/hp and total weight basis. (Diesels weighing only 5 to 7 lb/hp will be available.)

To Balance or Not

DOES tire and wheel balance make a worth-while contribution to tire life and ease of steering? There are divided opinions on this subject.

- One wheel maker, for example, reports that bus manufacturers insist that wheels be balanced; that truck makers don't feel the expense warrants it.
- One tire manufacturer claims that tire and wheel balance is rarely a cause of fast or irregular tire wear. The only possible justification for wheel balancing, he argues, is to eliminate front-wheel tramp or shake. Even then, it is only effective when the front end and the steering mechanism are in good mechanical condition and each wheel and tire is balanced as an assembly.
- A bus operator champions the cause of balancing. He feels that it is essential if maximum tire life is to be obtained.

Wheel Maker's Views

According to A. P. Schweizer, of Motor Wheel Corp., none of the wheels his company makes for trucks are balanced. It's not that Motor Wheel isn't equipped to do the job, noted this chief engineer. Rather, truck manufacturers apparently do not feel the increase in cost can be justified.

Schweizer did point out, however, that their truck wheels are held to a maximum of 3/32 in. radial and lateral runout. And vehicle makers have reported that wheels held within these limits do help them with their steering problems.

Wheels for buses, however, are a different case entirely with Motor Wheel. All of them are balanced to 20 in.-oz because bus manufacturers insist on it. As for radial and lateral runout limits, they are held to the same tolerances as truck wheels.

Tire Manufacturer's Slants

To Goodyear's W. E. Shively, tire and wheel balance is a much abused and much overrated problem.

It is rarely a cause of fast or irregular tire wear, he insisted, as has been proved by a number of well controlled tests. Actually, the only justification for wheel balancing is to eliminate front-wheel tramp or shake. Even then, said Shively, wheel balance is only effective when the front end and the steering mechanism are in good mechanical condition and the hub, brake drum, wheel rim, tire, tube, and flap are properly balanced as an assembly. Finally, even a satisfactory balance condition frequently changes to an unsatisfactory one in a few thousand miles of service.

Touching on radial and lateral runout, Shively maintained that when they are within commercial tolerances, they do not noticeably affect tire wear. Radial runout beyond reasonable limits will, however, cause front-end vibration, particularly at high speeds, he added.

Shively went on to say that vehicles vary considerably in what they can and can't tolerate in the way of out-of-balance and radial runout. Some makes, it seems, are much sturdier than others in this respect.

Drivers, too, were said to be a variable factor. Some will complain loudly about a vehicle which others will consider quite satisfactory.

Tires, according to Goodyear's Tire Design Manager, generally are commercially acceptable from the standpoint of balance and radial runout. Once in a while, however, there are tires which are unsatisfactory for use on sensitive front ends, he admitted. On the other hand, sometimes a heavy, thick spot in a tire tread will cause spot wear and this may be mistaken for out-of-balance or radial runout.

In short, Shively concluded, very few operators have been able to prove that tire and wheel balance actually pays for itself in reduced operating costs—at least not in the form of improved tire mileage.

Saying that it was not being very constructive to stir up an argument without offering some suggestions as to how to improve the situation, Shively recommended that the following be considered:

1. A vehicle manufacturer could determine the maximum out-of-balance and radial runout which his vehicle will tolerate in the tire and wheel assembly . . . and then establish tolerances for the various components. Suppliers should then have to meet these.

A manufacturer who has a sensitive vehicle may have to establish lower tolerances. But if these tolerances fall below practical production limits for the various components, he may have to pay more for the parts.

Even then, it will be necessary for the vehicle manufacturer to properly assemble the various components to assure the desired result.

to Balance?

That Is the Question

. . . whether tire and wheel balance makes a worth-while contribution to longer tire life and easier steering is a moot point in some circles.

R. W. Wantin, Ford Motor Co.

Based on secretary's report of Round Table on Tire and Wheel Balance for Longer Tire Life and Easier Steering held under the auspices of the SAE Truck and Bus Activity at the SAE Summer Meeting, Atlantic City, June 10, 1953. Panel Leader was F. B. Lutz, Budd Co.

(Most vehicle manufacturers no doubt already practice this procedure to some extent. But rather than expect all suppliers to furnish high-cost, low-limit parts to all vehicle makers (whether they need them or not), why not let the customer and supplier relationship function in the usual manner in respect to price to meet a specification? There's little doubt that suppliers can meet closer limits where the vehicle manufacturer requires it . . . and is willing to pay for it!)

2. A vehicle operator could use these two approaches to assure freedom from balance and runout troubles:

I Purchase only vehicles which perform satisfactorily when new. This would place responsibility on the vehicle manufacturer to deliver vehicles equipped with brake drums, hubs, wheels, and tires that are within close enough limits to perform satisfactorily.

II Then the operator, if he has a balance or runout problem (with front end and steering in good mechanical condition), can also specify that replacement tires, rims, and wheels be within tolerances to meet his particular needs.

The net of all this, Shively concluded, is that the fleet operator will be able to eliminate driver complaints, prevent some mechanical wear and tear on his vehicle, and in some cases eliminate damage to cargo. But he cannot hope to pay for it through increased tire mileage!

Bus Operator's Beliefs

In the opinion of N. M. Webb, Central Greyhound Lines' Manager of Maintenance, tire and wheel balance is essential if maximum tire life and ease of steering are to be obtained.

To get good average tire mileages, the complete steering mechanism must be properly maintained throughout the life of a bus, he asserted. Such things as camber, caster, tow-in, and steering-knuckle wear must be closely watched. And the front tires, wheels, drums, and hubs must be balanced as an assembly. The latter is especially important when new tires are installed, said Webb.

Certain Greyhound Divisions have, by paying strict attention to the steering-wheel mechanism, obtained an average tire life of 100,000 miles, it was pointed out. The Central Division, for example, has increased its average from 50,000 to approximately 75,000 miles per tire in the last few years. And Greyhound feels it has just scratched the surface.

Maximum tire life cannot be reached, however, unless the wheels themselves are manufactured to close tolerances, Webb noted. It is impossible to correct wheel balance if the wheel itself is not true in all respects.

Power Steering

Doing

TO really make truck driving easier, a power-steering system must do more than just reduce the physical effort required to steer the vehicle. (See Fig. 1.) It must also give the absolute maximum in responsiveness and natural operation. For without these things, it may be more difficult (mentally, at least) to handle a power-steered truck than a manually steered one.

There are lots of ways to go about getting these properties, but they all have one thing in common. They all are aimed at achieving the best combination of answers to these four performance considerations:

1. Should recovery to a straight-ahead position (near the end of a turn) be "snappy" or "not so snappy" when the driver's hands are removed from the wheel?

2. Should valve operation be sensitive as possible with respect to movement of the steering wheel?

3. What is a practical compromise between valve sensitivity and system stability?

4. Should the system have considerable "feel"?

Let's take a look at some of the various design approaches that are used to obtain optimum power-steering performance.

One way to get increased feel and recovery is to use a centering spring (shown at the left-hand end in Fig. 2) in the control valve. Washers at each end of the spring rest against abutments in the valve housing. These make it necessary to overcome the full inserted load of the spring in order to displace the valve spool in either direction. Thus, theoretically, the truck can be steered manually if the effort required does not exceed a certain rather low value.

Although a spring of this type is an aid to snappy recovery, it tends to bring about a two-stage type of valve performance which decreases valve responsiveness and reduces natural operation of the steering system.

The spring appears to improve stability under some conditions of speed and pavement and to detract from it under others.

Now let's consider what happens to steering-wheel rim effort when three different types of control system are used—one using hydraulic reaction only, one using a centering spring only, and one using both a centering spring and hydraulic reaction. Fig. 3 shows the relation between steering-wheel rim effort and steering-cylinder pressure for these three systems.

It can be seen that with hydraulic reaction only, the relation between cylinder pressure and driver effort on the steering-wheel rim is a straight line. When only a centering spring is used, the centering spring must handle the whole job of returning the steering mechanism to center and provide the desired "feel of the road." Thus, it ordinarily must be a fairly heavy spring, which means that considerable effort must be exerted on the steering wheel before the cylinder will begin to do any work. When both centering spring and hydraulic reaction are used, the spring load can be lighter. And once this load has been overcome, the straight line re-

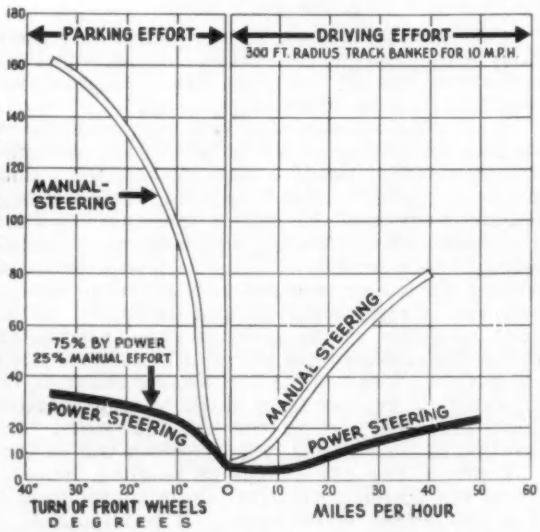


Fig. 1—Power steering can take a lot of the steering load off a truck driver

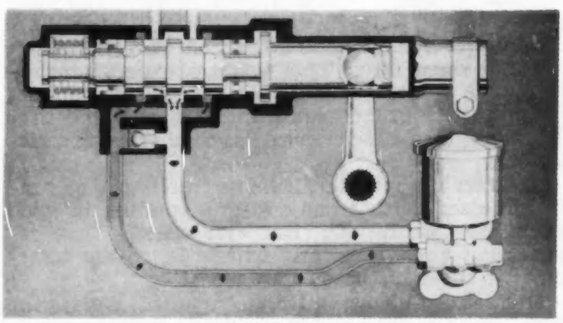


Fig. 2—One way to design more feel and recovery into a power-steering system is to use a centering spring at the left-hand end of the control valve

Should Epitomize What Comes Naturally

T. H. Thomas Bendix Products Division, Bendix Aviation Corp.

Based on paper "Easier Driving with Power Steering" presented at SAE National Transportation Meeting, Chicago, Nov. 3, 1953.

lationship between cylinder pressure and rim effort is again obtained.

Fig. 4 gives a more complete picture of the differences in the three types of systems. That's because the vertical scale on this chart shows the total torque going into the steering knuckles. This total includes both the effort put into the system by the power cylinder and that put in by the driver through the steering wheel.

This graph shows clearly the two-stage effect mentioned earlier as applying to valves incorporating centering springs. The inverted "knees" of the white and black curves at about 4 lb and 10 lb, respectively, are the approximate points at which the centering spring begins to be compressed. They are, therefore, the points at which manual effort begins to be supplemented by the effort of the power cylinder. With a centering spring only, the transition is from a very stiff system to a very sensitive or limber one. With a centering spring and hydraulic reaction installation, the transition is less noticeable. For that matter, it can be made less noticeable in systems using only a spring by making the spring rate quite high. But this brings about other problems. Because the change in spring load is relatively great per increment of travel, it is difficult to reconcile mechanical and hydraulic tolerances so as to obtain uniform results during left and right-hand turns.

Finally, let's see how the characteristics of a power-steering system can be changed by modifying the shape of the lands of the control-valve spool. (See Fig. 5.)

The solid black curve shows the relationship be-

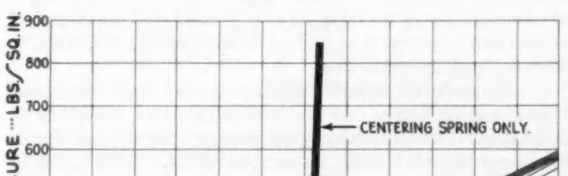


Fig. 3—Relation between steering-wheel rim effort and cylinder pressure for three different types of control system

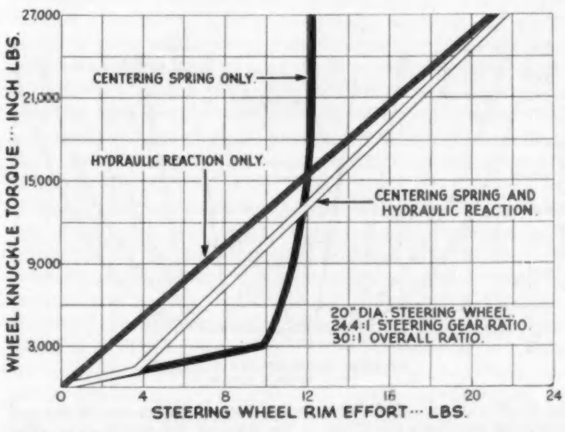


Fig. 4—These curves show clearly the two-stage type of valve performance obtained when a control valve has a centering spring

tween cylinder pressure and steering-wheel rim **travel** when spool movement is kept as small as possible commensurate with use of adequate passage areas. It can be seen that the steering-wheel rim can be moved slightly more than half an inch in either direction before the cylinder pressure rises appreciably. Upon reaching this half-inch travel, very little additional travel causes the pressure to rise from about 25 psi to the full pressure which can be supplied by the pump before the relief valve opens (about 850 psi).

Valve sensitivity can be reduced somewhat by narrowing the lands on the spool. This gives a large underlap of spool lands with respect to housing grooves, meaning that the spool must be moved farther to obtain a rise in pressure. This is shown in curve B.

Still another way to reduce valve sensitivity is to make the spool lands wider than the corresponding grooves in the valve body, but notch them so as to permit oil flow when the valve parts are centered. The solid white curve in Fig. 5 shows the type of response thus obtained. It can be seen that pressure rise occurs with practically no travel of the steering-wheel rim, but that considerable rim travel is required to obtain maximum pressure. This method of reducing valve sensitivity provides a way to guard against instability, such as shaking or fluttering, without resorting to complicated specialized arrangements. It is used in cases where the steering system tends to be resonant at some undesirable frequency.

Even more gradual pressure rise is obtained if a valve with a small underlap is equipped with notches, as shown in curve A. (This is desirable in some cases as a means of increasing stability.)

Finally, if the valve which produced curve B (large underlap) were modified by incorporation of notches, the extremely gradual pressure rise shown in the outer curve would be obtained. While this combination might result in very stable valve operation, it would be undesirable because of the excessive steering-wheel rim travel involved.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

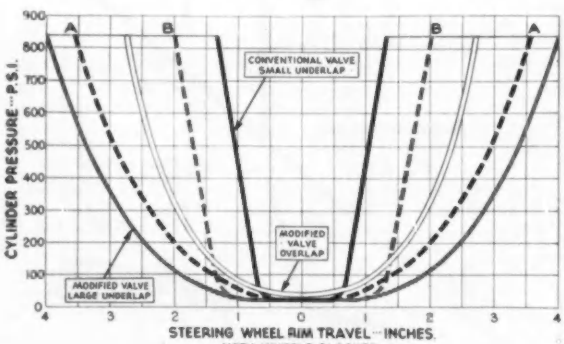


Fig. 5—The characteristics of a power-steering system can be changed greatly by modifying the shape of the lands of the control-valve spool (Curve A is for a modified valve with small underlap; curve B is for a conventional valve with large underlap)

Excerpts from Discussion . . .

Francis W. Davis
Consulting Engineer

WHEN we offer power steering to a driver, we should be careful to give him the desirable features without requiring that he learn a new set of driving conditions in the control of his vehicle. Instead of a "straight-line" relationship, we should strive for something that will give him the greatest driving satisfaction throughout the whole range of operation.

Manual steering is generaly considered desirable throughout a portion of the driving range and undesirable through another portion. Let's bear down on the latter and not interfere with the former. This is anything but a "straight-line" condition. It is easy to equip a vehicle with power steering without any reactionary effect from springs or otherwise. Maintaining directional control is entirely a mental and visual process. The other extreme is to load up the valve with springs and/or hydraulic reaction so that the driver is required to exert excessive manual effort to initially move the valve or to complete a parking maneuver.

A properly designed power gear of the so-called two-stage type gives the driver no sensation of cutting in or cutting out. In fact, we may end up with a gear with multistage reaction or a continuously variable reaction ratio.

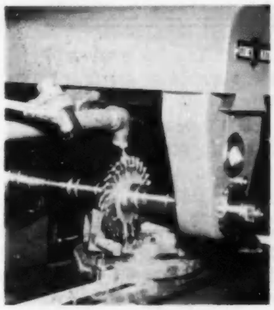
Consider the difference in reaction effect between moving and parking with present-day power gears. When the steering-wheel effort supplied by the driver is sufficient to swing the front wheels with the vehicle moving, the raction force reaches a definite point. Then for parking, which implies that the vehicle is at rest or moving very slowly, there is no point served in increasing the feel or reaction effect above this point. It only adds to physical effort on the part of the driver. This suggests a leveling off of reaction when reaching the condition indicated. A car equipped in this manner is very pleasing to drive as it gives the desired feel of the road in the low range, then levels off with extreme ease for parking.

There may be special applications, such as buses operating in cities, where steering-gear recovery is not altogether desirable and where reaction or feedback can be virtually dispensed with. This type of steering permits the driver to attend to his multitude of other duties and still maintain control of the vehicle. A short breaking-in or training period for the driver is usually indicated. However, serious damage can result to front-end linkage in heavy off-highway operation when reaction is absent. The driver cannot feel the obstacles encountered by the front wheels and is inclined to punish the vehicle. This has occurred in practice and is not just a matter of theory.

Summing up, then, there are no hard and fast rules on recovery and reaction effect. Different applications call for different characteristics. The subject needs further investigation and research.

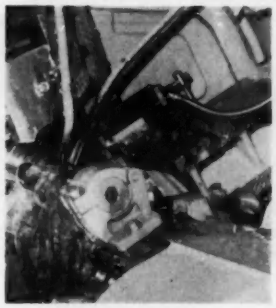
There is no magic formula for long tool life.

It hinges on:



1. Tool Design

2. Tool Materials



3. Cutting Fluids

4. Machine Condition

4 Factors That Affect Tool Life.

THERE is no formula to determine good cutting tool life. That has to be found for each job by looking at many factors . . . nature of the part to be machined, cutting tool material, cutting fluid, and machine condition are just a few of the main ones.

Some plants consider that 4 hr of operation is the minimum requirement. But even this will vary with material, rigidity of part, tools and machine, the replacement and resetting time for tools, and so forth. The vagaries of tool life on a given job are often difficult to understand even with a seemingly duplicate set-up. In one instance, 11,000 pieces were completed per grind on an automatic lathe grooving operation. After an accident, no amount of alteration could provide more than 300 pieces per grind. Granted, it's an extreme case, but indicative of the variation we must expect.

1. TOOL DESIGN: More than a Technical Job

The design, fabrication, application and maintenance of cutting tools are of prime consideration in the life of the tools. The roots of this aspect of the problem reach deeper than a technical consideration of the tool itself.

Tool and process engineers must apply the right tool of correct design to each job. All elements of the design must be recorded to provide the necessary information for fabricating and maintenance personnel to assure consistent quality. Those elements should be conscientiously applied by engineers whose abilities are developed through critical analysis of successful and unsuccessful applications. The development and use of design standards is a step in the better application of better tools; but a workable tool control system is required to assure that maintenance of tools is in accord with the specifications.

Tool grinding personnel must be better than average workmen and must be trained, instructed, and encouraged to develop into skilled operators. To eliminate turn-over in grinding personnel and to realize the savings possible with extended tool life, working conditions and pay must reflect the skill required. Tool inspection, time standards, centralized cutter grinding, development of specialists and good grinding machine tools and accessories all contribute to getting better tools at lower net cost.

The attitude of many manufacturers that any individual can be made into a cutter grinder with

D. Hopkinson,
Evinrude Motor Division, Outboard Marine and Mfg. Co.

Based on secretary's report of Machine Tools and Tooling Panel held as part of the SAE Tractor Production Forum, Milwaukee, Sept. 14, 1953.

a minimum of instruction is a fallacy. It costs incalculable production hours and uncounted tool dollars every working day.

2. TOOL MATERIALS: New Ones Are on the Way

In considering material for cutting tools, the tool engineer must consider the part material, type of cut, finish requirements, tolerance, machine tool and many other factors. Grooving Rb 100 cast iron to a ¼-in. depth with an 0.030-in. wide HSS slitting saw is a troublesome operation. Since carbide is impractical, an HS steel with high abrasion resistance is recommended. Switching to an 18-4-2 or 18-4-3 steel, or possibly T-2 or T-3, will increase vanadium content and wear resistance. These steels, though more difficult to fabricate, reduce the tendency toward corner wear.

Ceramic cutting tools which are hi-cut, fragile tools with no affinity for metal and a resistance to cratering, are being developed. These are not available on the commercial market, though some tools have been received from England for investigation.

A hi-alloy billet was machined with ceramic tools at 350 sfm, 3/16 depth of cut and 0.010 feed, removing metal at the rate of 8 cu in. per min with no indication of wear when the billet was gone. Ceramic tools may be used on titanium if used correctly (rigid set-up with heavy feeds, any hesitation of which is disastrous, in the neighborhood of 46 in. per min), although early results in high temperature alloys indicate no advantage.

Soft, abrasive materials—magnesium alloys, plastic, graphite and carbon—are most adaptable. Ceramics can be maintained with carbide equipment and may be compared to early days of carbide development when the general attitude was "It won't work! It's too fragile."

Heavy feeds are a necessity in many cases, especially on hi-alloys. Where finish requirements will tolerate heavy feeds, tool life can almost always be extended. In milling operations, determine load per tooth on cutter and establish feed to suit horsepower available and rigidity of setup.

Elevated surface speeds are not particularly advantageous unless power and rigidity of setup and cutting tools will economically stand increase in feed. This is not to discourage the highest practical speed, but only to affirm that increase in speed is without benefit unless it results in greater volume of metal removal without excessive increase in tool or machine trouble.

Experimentation with alloy steels has shown that surface speeds between 600 to 800 sfm result in the best work at lowest tool cost; 720 sfm was determined to be the optimum. Although operation at high speed can be used economically in production, much of the equipment in production departments today is not sufficiently rigid or adequately powered to take advantage of the findings.

3. CUTTING FLUIDS: Emphasis Now on Application

The selection and application of a cutting fluid or coolant is a major factor in the extension of tool life. The type of cutting fluid used is important but generally outweighed by application, provided a reasonably suitable selection is made.

Dual purpose types, machine lubricant and coolant, are not currently practical on most type machines. Chips in the oil act as a catalyst and also become welded to gear faces, ways, and other moving parts to cause machine troubles. Removal of chips by filteration has shown a marked improvement in tool life, though enough fine metallic particles remain to cause damage to the machine.

There is some tendency to go to stabilized oils with water displacing and corrosion resistant additives. But considerable attention is being given to chemical emulsion type coolants. It is thought that future operations will require water-type coolants to reduce the smoke problem at elevated surface feeds and heavier feeds.

The disastrous results of the cutting oil fed GM Livonia fire are expected to accelerate conversion to water solution coolants. All known water-mixed solutions at the present time have the disadvantage of corrosive effects of vapors that condense on machine recesses. Anti-corrosion inhibitors have adequately offset the corrosive qualities of the water in solution. However, machine designers have the only practical means of reducing condensation

damage through adequate venting. Several machine tool producers are taking remedial action on this problem.

For alloys with a very low rate of heat transfer the application of CO_2 has proved very effective, permitting increased speeds and feeds and maintaining size. In some instances the work has absorbed heat to an extent that cooling-off periods of 4 hr and up were required. Here CO_2 has been applied permitting continuous machining to complete the operation while maintaing tolerances of less than 0.0005 in.

The flow of gas must be directed and metered to maintain a desirable temperature of work and tool. Excessive flow will cause sub-optimum temperatures —as undesirable as the original high temperatures. The expense of the use of CO_2 is the factor that restricts its use to special application.

Wax as a cutting fluid has been used successfully on many operations. Its greatest value appears to be in tapping and threading where smoother threads, more consistent size, and longer tool life have been reported.

When applied between the work and the advancing edge of the tool, 80% of the effectiveness of cutting fluid was realized. Tangential application and flooding accomplished only 15% and 5% respectively. Application of cutting fluid is undergoing revolution with the advent of Oil Mist and Acro Jet vapor spray systems.

The Hi Jet system is beneficial on highly specialized applications; but operating at 400 psi presents a safety hazard comparable to medicine's jet type hypodermics. However, with an operating pressure of 20 psi using a 1/16-in. diameter nozzle, tool life has been tripled with the application of Acro Jet using a chemical solution type cutting fluid.

In the machining of steels with tungsten carbide cutting tools, the use of a cutting fluid is recommended. Since pressure on the cutting tool is the major cause of fracture, we must attempt to reduce that pressure. The application of cutting fluid is effective in two ways: the reduction of tool-chip interface temperatures and the reduction of friction. Both of these tend to increase the cutting ratio and will therefore reduce the fracture-causing pressures exerted on the tool.

Vapor spray applications, in addition to increasing tool life, can reduce the volume of coolant consumption and improve working conditions. That's especially so on high-speed milling operations and the machining of steel with carbide tools where smoke and splash would normally be common. Vapor spray applied between the cutting face and the work has the effect of cooling both the air surrounding the cut and the chips produced.

The low viscosity of the fluid and the pressure of application improve lubrication of cutting area and reduce power requirements. Or to restate and expand: with a given power supply, a greater volume of metal per minute may be removed with a reduction in tool maintenance and an improvement in working conditions while maintaining a more consistent size and better finish. However, to accomplish all this, the method of application (pressure, volume and direction) must be carefully controlled and guarded from accidental unbalance or maladjustment by unfamiliar personnel.

Since the cutting fluid is dispersed with the heat of the cut there is no lubrication of ways or other working parts, requiring additional attention to machine lubrication in some cases.

4. MACHINE CONDITION: Can Raise Hob with Tool Life

The condition of the machine affects the life of tools more than is sometimes realized and frequently efforts to eliminate tool troubles are fruitless until machine defects are corrected. It is primarily a responsibility of the operator, setup man, and production supervisor to request necessary continuous minor maintenance on production machines. General maintenance policy is to a large extent governed by the number of machines of a given type in the shop and the relation of schedules to capacity.

Wherever possible some plants use a preventive maintenance program, reconditioning hobs, gear shaping and shaving machines after approximately five years of operation and production lathes in a somewhat shorter period. Grinding machines are operated for about 10 years before automatic reconditioning. Lack of adequate and proper lubrication is given as the biggest cause of machine troubles and with conscientious well trained oilers. Possible savings of 40% in direct maintenance costs are cited.

The problem of machine tool replacement requires a solution tailor-made to suit the organization. While the MAPI replacement formula may not be workable in total, it may be adapted to establish a practical method for any organization. Any formula considering the essential factors will establish a consistent method of selection and provide most advantageous use of funds available for machine replacement.

The amortization of new equipment is affected greatly by our federal income tax structure and through Internal Revenue Department Regulation TD-4422 and bulletin "F," which arbitrarily establishes an average amortization period in excess of 20 years for machine tools. A machine that we may consider as "paid for" in two and one-half years of production, without the effects of federal taxes, will in fact not be paid for until seven years of production have been run through it.

But the big prize goes to him who can submit a practical system for the elimination (not simply the reduction) of the hammering of jigs, fixtures, and tools by shop personnel. Then to some extent rigidity, alignment, coolant application, and machine condition will prevail. Tool life will be further extended, machine maintenance reduced, and replacements due to machine failure decreased.

(The report on which this article is based is available in full in multilithographed form together with reports of seven other panel sessions of the 1953 SAE Production Forum held at the SAE National Tractor Meeting, Milwaukee, September 14, 1953. This publication, SP-303, is available from the SAE Special Publications Department. Price: $1.50 to members, $3.00 to nonmembers.)

Annual Meeting

continued from page 17

week, that is just about what SAE men were doing—both in the formal technical sessions and up and down the corridors in the more than 90 technical and administrative committee meetings sandwiched in between.

Technical sessions bulged with attendance as never before. The increased expanse of this year's facilities for technical sessions served only to emphasize the even more rapid increase in interest in SAE papers and discussions. The facilities-attendance relationship reminded one member of the crack by Dinner Speaker William Hazlett Upson about some of the hard-to-repair tractors of yesteryear. "The tractors really were good tractors alright," Upson quipped, "The only trouble was the salesmen were better." The expanded facilities for the 1954 meeting were really good. Only trouble was, the attendance was better.

In seven separate reports on following pages, significant technical highlights are reflected from the major engineering areas touched by the wide variety of papers presented. . . . And following each of these highlight reports are one or two significant statements—designed for easy reading—selected from each of the papers.

In later issues, SAE Journal will carry individual abridgments of each of these papers, along with an abridgment of both the oral and written discussion which took place in connection with each paper.

Residual Stresses . . .

. . . are blamed for many part failures. But they can be beneficial if they oppose, instead of add to, service stresses.

DETECTIVES from the ranks of production men, metallurgists, and designers accused residual stresses of inciting a variety of metal failures.

They traced sudden cracking, fatigue cracks, spalling, and stress corrosion to stresses that steal in during manufacture.

Residual stresses build up when different portions of a part cool at different rates through the critical 1400–600 F range. Here's how metallurgists theorized it happens: 1. Steel phases tend to contract as they cool. The slower cooling portions are restrained from contracting by surrounding layers, and tensile stresses result. 2. Volume changes accompanying phase changes also contribute stresses—which may oppose thermal stresses.

Differential cooling is the chief source of residual stress in forgings and castings. Grinding, machining, forming, and welding can also introduce residual stresses, production men added.

Differences in cooling rates were shown to have caused stresses that cracked engine blocks even before they were used. Brittle lacquer and strain gage evidence proved that residual stress was the culprit and gave clues that pointed the way to the cure. They indicated that prompt removal of core sand from valve chambers would tend to equalize cooling rates and eliminate stresses. Service experience has confirmed that this procedure prevents the cracks.

Spalling—the characteristic surface flaking of heavily loaded contact surfaces—was also explained in terms of residual stress. A cross-section through a spall on a bearing ball suggested that the failure started well below the surface in an area stressed in tension, and progressed radially outward to where stress became compressive. Then the fracture veered off perpendicularly until it broke to the surface—a shift attributed to the steep residual stress gradient plus stress imposed by the race.

Littlewood Evidences Strong Interest in Safety

William Littlewood, 1954 SAE President, evidenced his strong interest in safety, both in the air and on the ground, when he said in his inaugural address at the Annual Meeting Dinner:

> **"One subject very dear to my heart, and, I know, very active in the thoughts and work of all automotive engineers, is that of transportation safety. The ground rules are essentially the same in all walks of life. They are particularly similar in the design and operation of automotive vehicles—be they land or air.**
>
> **"We have all worked hard in this important field of human engineering and much has been accomplished. Our automobiles and our airplanes are today much safer for the passengers who travel in them—and to the public as well.**
>
> **"However, much remains to be done, and I sincerely hope that the coming years will see even more emphasis, energy, and accomplishment in these areas."**

Metallurgists are suspicious of residual stresses as accomplices in stress corrosion, too. This is a form of cracking reported to occur in stainless steel compressor blades along edges where grinding operations set up residual stresses. Stress relieving is one cure. Even more effective are additions of molybdenum and vanadium to the alloy and reduction of hardness level, it was reported.

One discusser suggested that the mechanism of stress corrosion might be this: Ionized hydrogen from water vapor penetrates between grains. When the hydrogen ions pick up a charge, they become hydrogen atoms of greatly increased diameter, capable of prying one grain away from another.

Others present agreed that grain boundary energy is involved in stress corrosion, but they weren't convinced that hydrogen does the damage. One refutation advanced was that stress corrosion occurs mostly in a compressor's first stages—not in the later stages where the higher temperatures vaporize more of the water in intake air.

Built-in stresses are guilty of ruining many a helicopter propulsion part, according to participants in an all-day symposium on fatigue. But the right kind of built-in stresses—usually compressive surface stresses — can lengthen fatigue life. Several helicopter manufacturers reported that shot peening has benefited certain parts that tended to fail unexpectedly early in service.

Engineers did not bring in a unanimous verdict on shot peening, however. One participant felt that shot peening can't correct cracks and can obscure them so that they are not discovered. Shot peened parts, even though their life may be extended, are more likely to fail suddenly. They don't show the typical slowly propagating fatigue crack that visual inspection can disclose before complete failure.

The consensus was that while shot peening can be a good fix in many cases, we don't know enough about residual stresses to rely on it for original design.

SAE Leadership Changes Hands . . .

. . . as it does each January. This year, 1953 SAE President Robert Cass (right) greets 1954 SAE President William Littlewood (left) at the Annual Dinner where both were speakers

Cooling Sets Up Stress

We are satisfied that the relative cooling rates of different portions of complex castings after solidification are the most important factor in residual stresses.

Over the important range from 1400 to 600 F, a casting 36 in. long must contract over ¼ in. This gives an idea of the stress possibilities when different portions are cooled at different rates . . .

. . . **R. E. Vandeventer and Forest McFarland**, Packard Motor Car Co., "Measurement and Control of Residual Stresses in Cylinder Block Castings."

Stress Left by Grinding

Grinding stainless with the outside diameter of a wheel produced a surface layer 0.001 in. deep stressed in tension. Grinding with the side of the wheel produced a surface layer 0.015 in. deep stressed in tension.

This suggests that the larger the contact area, the greater the volume of material stressed in tension. Though surface stresses are about the same, the depth of stress is less for small contact areas . . .

. . . **R. L. Mattson**, Research Laboratories Division of GM, "Effects of Residual Stress on Fatigue Life of Metals."

Mo-V Stainless

Tests show that 12% stainless steels with molybdenum and vanadium added withstand stress corrosion better than conventional stainless steels.

Time to failure at a given hardness and stress in a hydrochloric acid plus selenium dioxide solution is much greater for the alloy-modified stainless . . .

. . . **W. L. Badger**, General Electric

Co., "Stress Corrosion of 12% Cr Stainless Steel."

Fretting

Fretting is one type of failure that doesn't seem to be connected with residual stress.

One plausible explanation of fretting is that at the interface of a plastically deformed metal-to-metal junction, two high points adhere mechanically. When the tangential force is great enough, the break occurs not at the strain-hardened zone of contact, but some distance away.

The broken-off particle may flash weld to the other projection because of frictional heat. Or it may adhere mechanically or drop off. Because it's hot, it oxidizes readily . . .

. . . **F. W. Fink**, Battelle Memorial Institute, "Review of Fretting Corrosion Theory."

Fretting Corrosion

Here are some ways of alleviating fretting corrosion of bearings:

Flood bearing with lubricant of maximum feedability. Relubricate frequently to flush out fretting debris. Harden one steel surface. Coat rubbing surfaces with rubber or rubber cement. Vapor blast, anodize, bake on Teflon, or apply a nonferrous metal coating . . .

. . . **E. M. Johnson**, The Texas Co., "The Effect of Lubrication on Fretting Corrosion."

Locked-In Loads

The lug attaching a helicopter transmission to the fuselage failed. Investigation revealed that second order engine loads were the main oscillating stresses. Also to blame were steady, locked-in loads due to manufacturing tolerances on bolt holes and on mounting face alignment on three lugs supporting the transmission.

Mounting the transmission through Fabreeka bushings and washers cured the trouble . . .

. . . **Harry Tobey**, Piasecki Helicopter Corp., "Secondary Fatigue Loading of Helicopters"

Lead between Grains

When an Inconel X tail cone failed in fatigue, metallurgical analysis showed the presence of lead in the grain boundaries of the parent metal.

At about 1325 F, it appears, the lead carbonate formed in the engine changes to lead oxide. Then it rapidly penetrates grain boundaries. This, coupled with even low periodic stresses, can result in failure . . .

. . . **R. M. Carlson and F. D. Schnebly**, Hiller Helicopters, Inc., "Service and Testing Observations of Fatigue Failures in Helicopter Components."

Stress Counter Needed

If fatigue life data should be treated statistically—as most helicopter designers feel—then the occurrence of fatigue stresses in service should also be treated statistically. It doesn't make sense to be precise in one case and arbitrary in the other.

We need to decide what stresses to count, then develop a counter to record them . . .

. . . **H. T. Jensen**, Sikorsky Aircraft Division, "The Problem of Relating Accumulated Service Fatigue Damage to Remaining Life"

Production Fatigue Testing

We used a fatigue test as a spot check on production quality of an engine mount. Small cold shuts and slag inclusions where the weld was stressed in tension reduced life 30%. Frequent rework was required to eliminate these weld defects and insure success in the test.

On the basis of production experience, the mount was finally redesigned for lower stress concentration, less welding, heavier-walled tubing, and lower overall stresses . . .

. . . **R. F. Breyer**, Bell Aircraft Corp., "Fatigue Proofing Helicopter Components."

Pearlitic Malleable

Pearlitic malleable iron provides good resistance to fatigue.

Where a part can be designed to perform satisfactorily as a pearlitic malleable iron casting, the economics of the finished machined part generally favors the casting. We are now working on crankshafts, connecting rods, valve lifters, distributor gears, air conditioning parts, and many others . . .

. . . **C. F. Joseph**, Central Foundry Division of GM, "Pearlitic Malleable Iron, Its Properties and Expanded Uses."

Determining *K*

K, the coefficient of heat transfer, for friction materials can now be determined by analogs. That's because heat conductivity is directly related to electrical conductivity.

New, accurate knowledge of *K* is aiding in solution of problems involving heat flow and temperature gradients in brakes and clutches . . .

. . . **C. S. Batchelor and E. L. Carey**, Raybestos-Manhattan, Inc., "Friction Facts, Fortes, and Foibles."

Stresses in Ring Gears

We have developed an unusually accurate procedure using the strain energy method for finding maximum stress and radial deflection in a ring gear.

The method determines the most flexible ring gear that will have adequate strength. The more flexible the ring gear, the more uniform the load distribution among the planet gears and the better the utilization of available strength . . .

. . . **Joseph Marin**, The Pennsylvania State College, and **R. H. Shenk**, consulting engineer, "Stresses and Deflections in Planetary Ring Gears."

Automotive Engine Research . . .

. . . fathers new engine and supercharger; breeds better fuel and lubes; and gets a chance to adopt new preflame-reaction study tools.

AUTOMOTIVE engine research got far more than the proverbial day in court at this meeting. It got no less than five days to bring its case up to date. And as the evidence piled up, these things became apparent:

1. Research has led to three new products—an overhead-valve V-8 engine, an automatic transmission, and an automotive-engine centrifugal supercharger.

2. Research has uncovered new ways to improve fuels and lubri-

cants . . . and to give automotive engines more power.

3. Research has acquired two new techniques for studying precombustion reactions.

Research was the force behind all three of the new automotive power-train components described at the meeting. It moved Ford engineers to design a short-stroke overhead-valve V-8 engine with the utmost in structural rigidity. It influenced Chrysler's decision to use a new steering-column shift pattern for its new 4-element torque-converter transmission. And it was responsible for McCulloch Motor's being able to develop a 30-lb centrifugal supercharger that can add 40 hp to the output of an automotive diesel run on present-day fuels.

Researchers in the fuels and lubricants area had some new discoveries to talk about too. A new refining process—catalytic reforming—can upgrade poorest straight-run gasolines to 98-octane fuel, it was reported. To engine designers present, this came as good news. As one put it: "We're in an excellent position to take advantage of such high-octane fuels. With them available, we can make the minor changes in engine design necessary to get 10 to 1 compression ratios . . . and they mean a dividend in fuel economy."

Recent findings on the value of gasoline and motor oil additives also were added to the literature. Some reports indicated that these materials help to cut down the deposit-forming tendencies of fuels and lubricants; other test surveys indicated that such additives often do more harm than good.

Still other research was said to have given the piston engine a powerful new weapon in its struggle against the turbine engine for future powerplant supremacy. The weapon: high-pressure turbocharging. With it, the specific output of both diesel and gasoline engines can be increased far beyond anything thought possible a few years ago, stated one engineer.

Insofar as powerplants of tomorrow are concerned, however, another engine man felt the free-piston and turbine compound engine is a real dark horse. This combination offers mechanical simplicity, relatively low specific weight, excellent speed-torque characteristics, and fuel economy comparable to a diesel engine, he noted.

But products of research weren't the only new things to get attention at the meeting. Research tools got into the limelight too. Described were two improved techniques for studying engine preflame reactions.

A motored engine was said to be better than a fired engine for making such studies because it offers a much greater degree of control. What's more, recent tests indicate that a motored engine duplicates in every respect the precombustion reactions which occur in a normally operated engine, it was pointed out.

But whether a motored or a fired engine is used, a new and better way now exists for evaluating the net energy released during preflame reactions, chimed in another participant. He explained that this method is based on a fuel-air mixture energy balance . . . and requires use of an electronic calculator.

Chrysler Transmission

Chrysler's new PowerFlite transmission combines a 4-element torque converter with two planetary gearsets hydraulically controlled by a multiple-disc clutch and two bands.

The unit provides, along with neutral, a driving, a low, and a reverse range. These functions are easily selected by a steering-column lever which has a simple and convenient shift pattern . . .

. . . **W. R. Rodger and A. J. Syrovy,** Chrysler Corp., "The Chrysler PowerFlite Transmission."

Ford's New V-8

Ford's new overhead-valve V-8 is a short-stroke engine built for high performance and long life. It contains many special features: integral valve guides, full-flow oil filtration, and high-turbulence combustion chambers. But its most noteworthy forte is its structural rigidity.

Ford engineers believe that superior rigidity is a must for smooth and durable operation with today's higher compression ratios and tomorrow's higher octane fuels . . .

. . . **Robert Stevenson,** Ford Motor Co., "The New Ford V-8 Engine."

Automotive Supercharger

A new 30-lb centrifugal supercharger can add 40 hp to the output of an automotive diesel run on present-day fuels.

Besides being compact, this variable-speed V-belt driven unit has a low noise level, a service life equal to modern automotive engines, and a lubrication system requiring a minimum of attention.

It also provides maximum air pressure over a wide operating range, protection against overspeed, and a low speed economy range . . .

. . . **J. W. Oehrli,** McCulloch Motors Corp., "Development of the McCulloch Supercharger for Automotive Diesel and Gasoline Engines."

S O S: Turbocharging

High-pressure turbocharging has added new strength to the reciprocating engine's struggle with the gas turbine for future powerplant supremacy. It can increase the specific output of both diesel and gasoline engines (large and small, 2-cycle or 4-cycle) far beyond anything thought possible a few years ago.

What's more, high-pressure turbocharging decreases both mechanical and cooling losses, and reduces specific fuel consumption as much as 30% . . .

. . . **Rudolph Birmann,** De Laval Steam Turbine Co., "New Developments in Turbocharging."

Oil Versus Fuel Economy

Under carefully controlled conditions, lighter grade motor oils will give better engine fuel economy. In a laboratory test, for example, an SAE 5W oil gives 3 to 6% more miles per gallon than an SAE 20 or 20W oil.

But under the varying conditions to which passenger-car engines are subjected, such a gain will not be realized . . .

. . . **Carl W. Georgi,** Quaker State Oil Refining Corp., "Some Effects of Motor Oils and Additives on Engine Fuel Consumption."

Deposit Cutter

Crankcase-oil contribution to the formation of combustion-chamber deposits can be reduced. It's just a matter of using distil-

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Annual Meeting Dinner . . .

. . . had a larger attendance than ever before.

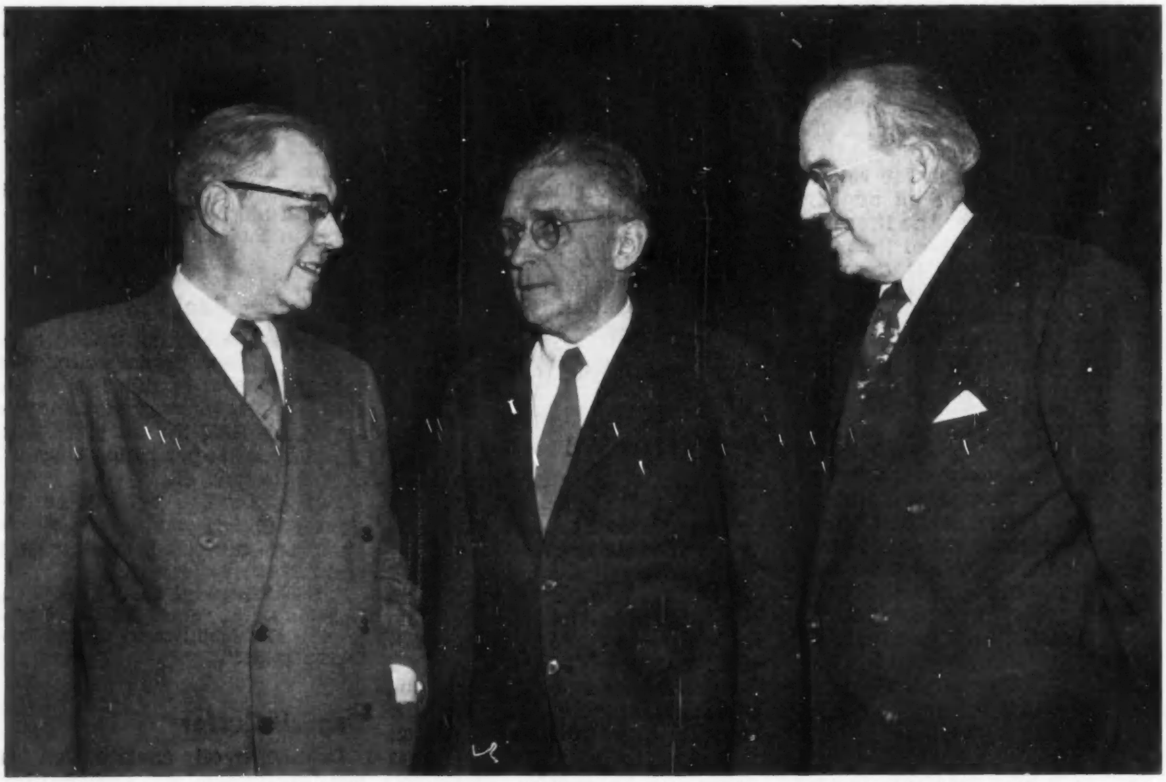
THE 1954 SAE ANNUAL MEETING DINNER was featured by attendance of many of the industry's executives, presentation of the Detroit Section's Henry Ford Memorial Award for 1954 by Henry Ford II in person, and inaugural and "farewell" addresses by SAE's 1954 and 1953 Presidents respectively. Attendance—larger than ever before—was close to 4,000.

Its program was opened by Detroit Section Chairman K. E. Coppock's welcome to the members and guests who attended. . . . And it was capped by another strikingly successful combination of humor and homespun philosophy from William Hazlett ("Alexander Botts") Upson, whose first appearance in 1948 had kept cries of "Encore!" ringing from SAE members ever since.

1953 SAE President Robert Cass confined his remarks to brief and sincere words of thanks and appreciation to all those individuals and groups who had worked with him throughout the year in the interests of SAE.

1954 President William Littlewood, vice-president, American Airlines, charted the lines of sound growth for SAE in his inaugural address, and stressed the purpose and possibilities for individual growth by automotive engineers. Speaking especially to young engineers, he urged: "Be a 'joiner' and be a 'doer.' Ally yourself in engineering with others similarly interested and engaged. By technical and friendly association, debate and exchange of ideas, you may develop your own abilities and broaden your knowledge, experience and judgement. . . . Be active. Work on committees; write papers; stand on your feet and speak. If you do these things, you will reap untold benefits for yourself, for your associates in engineering and industry, and for your country."

"Henderson" and "Botts" in Person



Gilbert Henderson, president of William Hazlett Upson's mythical Earthworm Tractor Co., was revealed at the dinner as having been partly modelled after Louis B. Neumiller, president of Caterpillar Tractor Co. (left). Neumiller was master of ceremonies at the after-dinner program where Upson (center), creator of Alexander Botts of Saturday Evening Post story fame, was the principal speaker. With them is Kenneth E. Coppock, Detroit Section Chairman, who opened the after-dinner program on behalf of the host Section.

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late base stocks and selected additives.

A new type of oil so formulated will allow more high-compression cars to be operated satisfactorily on the fuels available today . . .
. . . **R. L. Overcash, W. Hart, and D. J. McClure,** Kendall Refining Co., "Crankcase Oil—An Approach to the Combustion Chamber Deposit Problem."

Gasoline Additives

Salts of alkaline metals seem to offer little promise as combustion catalysts. They do not effectively remove carbonaceous deposits from combustion chambers.

As for deposit modifiers (which alter deposits enough to render them harmless), none of those studied to date appears to offer sufficient advantages to offset its disadvantages . . .
. . . **C. O. Tongberg, N. V. Hakala, L. E. Moody, and J. B. Patberg,** Esso Laboratories, Standard Oil Development Co., "Gasoline Additives."

Deposit Slasher

Combustion-chamber deposits and fuel octane requirements can be significantly reduced by specially prepared oils. Mixing proper combinations of these ingredients—base stock, volatility, additive type and content—will do the trick. The fact that outstanding overall lubricant performance can be obtained with these blends is frosting on the cake . . .
. . . **J. G. McNab, L. E. Moody, N. V. Hakala,** Esso Laboratories, Standard Oil Development Co., "The Effect of Lubricant Composition on Combustion Chamber Deposits."

What's Bad About Deposits

Volume and heat capacity of a deposit determine how much it will increase engine octane-number requirement, recent tests indicate. Thermal insulating effect of a deposit doesn't seem to be an important factor in increasing octane-number requirement . . .
. . . **Joel Warren,** Ethyl Corp., "Combustion Chamber Deposits and Engine Octane Number Requirement."

Preflame Energy

A new and better way now exists for evaluating the net energy released during preflame reactions. Applicable to either motored or fired engines, this method is based upon an energy balance for the fuel-air mixture in the engine cylinder.

With this improved technique, it is possible to obtain a smooth energy release rate curve for preflame reactions—a detailed effect not obtained with two previous methods of analysis . . .
. . . **D. R. Olson, J. T. Wentworth, W. A. Daniel,** Research Laboratories Division, GMC, "The Evaluation of the Energy Released During Preflame Reactions."

"Early" Reaction Studies

A motored engine is the thing to use for studying precombustion reactions. This tool offers a much greater degree of control over these reactions than a fired engine does.

Even more important, recent tests indicate that a motored engine duplicates in every respect the "early" reactions which occur in a normally operated engine . . .
. . . **W. C. Davis, M. L. Smith, E. W. Malmberg, and J. A. Bobbitt,** Ohio State University, "A Comparison of the Intermediate-Combustion Products Formed in an Engine With and Without Ignition."

Octane Booster

A new refining process—catalytic reforming—can upgrade poorest quality straight-run gasolines to an octane number level above that of present premium grade gasoline.

The resulting 98-octane fuel would, it is true, cost more per gallon. But it would end up giving more miles per motorist fuel dollar if engines were developed to take full advantage of its high octane rating . . .
. . . **W. M. Holaday,** Socony-Vacuum Laboratories, "What Can We Get from Higher Octane Number Fuels."

Diesel Misplay

Automotive diesel cylinder-head and gasket troubles today

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Horning Memorial Award

Mrs. H. L. Horning presenting the 1952 Horning Memorial Award to Lloyd Withrow (left) and F. W. Bowditch for their paper, "Flame Photographs of Autoignition Induced by Combustion-Chamber Deposits." J. C. Geniesse, chairman of the Horning Memorial Board of Award, looks on. Story of the award is given on p. 76.

EVENTS at the Meeting

HENRY FORD II presents the Detroit Section's Henry Ford Memorial Award for 1953 to T. D. Kosier. Kosier's paper on "Transition Curves for Speedways and Highways" was adjudged the best paper submitted in the Award contest, which is open to any SAE Junior member. Kosier is assistant section supervisor, Engineering Test Section, Ford Motor Co.

SAE PRESIDENT WILLIAM LITTLEWOOD talks to reporters a few hours before announcement of his election as 1954 leader of the Society . . .

WJR NEWSCASTER JACK WHITE interviews SAE President William Littlewood on SAE, its objectives and accomplishments. On this Jan. 16 broadcast, Littlewood told of SAE growth and of technical achievements of SAE members and groups.

1951 SAE PRESIDENT DALE ROEDER (right) is awarded a life membership in SAE as his post-presidential term as a member of SAE Council expires. Making the presentation is 1953 SAE President Robert Cass.

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arise from errors of omission on the part of their makers and errors of commission by their users.

In the eyes of fleet operators, manufacturers ought to give more attention to bringing the life of these components up to that of engine blocks.

To manufacturers, fleet operators could improve the situation measurably by teaching better driving habits and using better maintenance procedures . . .

. . . **L. E. Kassebaum**, Consolidated Freightways, Inc., "Automotive Diesel Engine Head and Gasket Problems."

Drive Lines for V-8's

It's only a rumor that several truck engines on the way will be V-8's with speeds almost double that of current 6-cyl engines. But it's a fact that if this is true (and it appears to be), then all units back of the engine—clutch, transmission, propeller shaft, and axle—will have to be revamped too . . .

. . . **W. P. Michell**, Spicer Mfg. Division, Dana Corp., "Drive Line for High Speed Truck Engines."

Piston-Turbine Wedlock

The marriage of the free-piston engine and the turbine engine can be an extremely happy one.

By joining this couple in wedlock, it's possible to achieve (1) mechanical simplicity, (2) relatively low specific weight, (3) excellent speed-torque characteristics, (4) vibration-free operation, and (5) fuel economy comparable to a diesel engine . . .

. . . **A. L. London**, Stanford University, "The Free-Piston and Turbine Compound Engine—Status of the Development."

Lockheed Lodestar is being modified by Lear, Inc. and called the Learstar.

Part of the marked improvement in performance is due to smoothing of wing surfaces to prevent wasteful turbulence. Addition of filler like that used in passenger car bodies evens out any ripples in the wing. Then the wing is polished until a three-point surface gage shows roughness is within 0.002 in. (The technique was developed at Mississippi State College in connection with boundary-layer control research carried out in sailplanes.)

The National Business Aircraft Association has surveyed members' needs and prepared rough preliminary designs for high-wing and low-wing, two-engine and four-engine, airplanes, an NBAA representative disclosed. Data is available to prospective manufacturers, although not to the general public.

Executive aircraft users present expressed desires for aircraft that will have a range of 1800–2000 miles, pressurized cabins, and dependable take-off from a 3000-ft runway.

'Copter Costs . . .

. . . temper airlines' enthusiasm, but special abilities of helicopters attract other users.

HELICOPTERS would cost airlines too much to operate, but they're fine for an increasing number of off-beat jobs where their landing and take-off capabilities justify their expense. The helicopter was praised even for executive transport—as was the Lear-modified Lodestar.

At an estimated $203 per flight hour or 12¢ per passenger-mile, the proposed 30-passenger helicopter can't compete with the $128-per-hour Convair, even on 50–100 mile hauls. Not until helicopter operating costs drop much lower will airlines adopt it for general short-haul service, an airline executive told an audience dotted with helicopter manufacturers.

No one contradicted him on this score, either. But a number of special applications were brought out. Three of them were:

- Sabena is operating helicopters between the centers of Brussels, Rotterdam, and other European cities. The service doesn't directly pay for itself. But Sabena hopes it will pay off by feeding extra passengers to its long-haul service. Over 100 of the transatlantic passengers Sabena carried last summer were apparently attracted by the helicopter service.

- Helicopters lifted all materials for a 21-family village from a 1300-ft elevation to a 5000-ft location several miles away. This was in a remote, mountainous region of Canada where workers are building a high-power electric line.

- The Port of New York Authority uses its two Bell 49 G's for speeding its executives from its Manhattan offices to its four metropolitan airports and its many bridges and tunnels. The helicopters are invaluable for traffic studies and photographic missions, too.

For the executive whose needs are better satisfied by an airplane than a helicopter, the well proven

'Copters Cost Too Much

Operating costs run about 12¢ per passenger-mile in a 30-passenger helicopter, it is estimated. This makes it very doubtful that helicopters will soon come into general airline use.

They may, however, serve in special situations. For example, Detroit-Cleveland trains take 3 hours to go around the lake and charge $5.56. Airports are not close at either city, so airplane-plus-limousine takes 2¼ hours and costs $10.20. Helicopters could make it in just over 45 minutes, and at 12¢ per mile, the fare would be $12.60 . . .

. . . **W. L. McMillen**, American Airlines, Inc., "An Airline View of the Helicopter."

Future Helicopters

There's no limit on potential helicopter size. Capacities of 30 or 35 passengers are entirely feasible.

The "giant" helicopters of the future may not have such very large rotors. They may just have higher disc loading.

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Among the Guests at

1. C. A. Chayne (left), vice president, charge of engineering, General Motors Corp., and SAE Past-President J. C. Zeder, vice-president, director of engineering and research, Chrysler Corp.

2. Left to right, SAE Past-President C. F. Kettering, General Motors Corp., SAE Past-President A. T. Colwell, vice-president, Thompson Products, Inc.; and Henry Ford II, president, Ford Motor Co.

5. Left to right, SAE Vice-President for Air Transport, R. W. Rummel, chief engineer, Trans-World Airlines; Major-Gen. A. Boyd, commandant, Wright Air Materiel Center, Wright Field; and SAE Vice-President for Aircraft, F. W. Fink, chief engineer, Consolidated Vultee Aircraft Corp.

6. Left to right, SAE 1953 Vice-President for Aircraft Powerplant, E. G. Haven, manager, Aviation Divisions, General Electric Co.; SAE Past-President Arthur Nutt, director of engineering and contracts, Bridgeport Lycoming Division, Avco Mfg. Co.; and R. T. Hurley, president, Curtiss-Wright Corp.

Pre-Dinner Reception

3. J. A. C. Warner (left), secretary and general manager of SAE, and Major-Gen. L. E. Simon, chief of research and development division, Army Ordnance Dept.

4. SAE Past-President A. W. Herrington (left), chairman of the board, Marmon-Herrington Co., and R. F. Black, president, White Motor Co.

7. Left to right, Lt.-Gen. E. W. Rawlings, commander, Air Materiel Command; Rear Admiral R. S. Hatcher, assistant chief of research and development, Navy Bureau of Aeronautics; Lt.-Gen. O. R. Cook, deputy chief of staff, materiel, USAF; J. D. Redding, executive director, Committee on Aeronautics, Research & Development Board, Dept. of Defense; and Ralph S. Damon, president, Trans-World Airlines, Inc.

8. Reception Committeeman R. F. Steeneck (left), district manager, Cleveland, Fafnir Bearing Co., and Capt. J. H. Summer, Air Materiel Command.

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Tip jets will have limited use because of their high fuel consumption and short range. We don't need them to get around transmission problems. There's no permanent reason why a good helicopter transmission can't be as good as a good automobile transmission.

Speeds of 150–175 mph appear to be the helicopter's maximum because of compressibility problems with the blade . . .

. . . **Igor I. Sikorsky**, Sikorsky Aircraft Division, "Helicopters in Transport Service"

Lodestar into Learstar

I recently flew our prototype Learstar at normal cruise power from Chicago to Los Angeles, staying just four minutes ahead of a scheduled DC-6 all the way.

The Learstar is our reworked version of the Lodestar. Besides cleaning it up aerodynamically and adding fuel tanks to extend operating range to 3000 miles, we have cut cabin noise and vibration levels. It seats 10 passengers and can sleep two . . .

. . . **W. P. Lear**, Lear, Inc. "The Modern Executive Airplane as a Medium of Transportation." Paper presented by Dr. August Raspet of Mississippi State College.

Production Men Alert . . .

. . . to varied, sudden demands on manufacturing, but plead for closer partnership with aircraft design engineers.

THE old saw that "an ounce of prevention is worth a pound of cure" pretty well sums up the job ahead that manufacturing men saw for themselves at the SAE Annual Meeting. Return of a buyer's market and continued product complexity compel the production engineer to anticipate the unexpected . . . be it in plane manufacture, gear fabrication, plastic body production, or plant protection.

Aircraft factory men lamented in unison the "surprise packages" often laid in their laps by design engineers. These production men argued that they couldn't plan and forestall manufacturing bottlenecks if they aren't brought in on new designs or design changes early enough.

They also griped about the "chicken-and-egg" state of modern plant equipment acquisitions. The production group can't buy any new machinery unless engineering releases designs needing such equipment. And engineering refrains from submitting designs calling for advanced machinery not in the plant.

Lockheed overcame this by installing its "Hall of Giants," a group of large machines and equipment, before there was a need for them. By the time the machines were installed, parts were designed and production schedules developed which would keep these machines busy for two to three shifts.

One engineer said that Lockheed's Hall of Giants may well be a Hall of Pigmies tomorrow. The heavy forging and extrusion presses being built for the Air Force are expected to do this. They'll broaden the horizons of design possibilities for aircraft engineers.

Automotive production men observed that their industry can't afford any casual or haphazard coordination between manufacturing and engineering. That would be catastrophic for high-quantity production involving heavy tooling and equipment investment.

Chevrolet's plastic body Corvette was cited as a case in point. Here the designers and factory men together ferreted out the possible troubles with reinforced plastic, worked out answers before going into production.

The original Corvette body was made of reinforced plastic purely as an expedient. Chevrolet expected to go to a steel body in production models. But engineering found the plastic body practical from a performance and service standpoint. Manufacturing was told by the plastic industry that it was practical productionwise.

So Chevrolet's engineers and production men launched an extensive survey of reinforced plastic fabricating techniques. They set up a development program to come up with the most suitable type of plastic resin and fibrous glass material. Result: a production line using matched metal dies that has started to spew out the first of 10,000 Corvettes to be produced in 1954.

Gear men at the meeting showed they won't be caught by surprise when management asks them to reduce costs in the face of keener competition. They have evaluated various gear fabricating methods and have come up with more economical techniques that designers and shop men welcomed. Designers perked up because the methods won't penalize gear performance or service life; the production men—because material and labor costs could be cut.

A case in point was a tractor final drive gear that had been made of SAE 8620 steel, carburized and direct quenched. Cost per gear was reduced $2.41 by switching to an induction hardened gear of SAE 1050 steel. What's more the induction hardened gear had a considerably higher tooth beam strength.

Factory management was told literally how to put out the fire before it happens. Safety engineers, industrial architects, and plant men agreed disastrous industrial fires can be nipped in the bud if plant management satisfies these five musts of fire protection: (1) safe plant construction, (2) complete sprinkler systems, (3) ample water, (4) employees trained in fire fighting, and (5) top management support on fire prevention.

Corvette Goes Plastic

To make the production model of the Corvette with a steel body or with reinforced plastic—that was the question. We toured reinforced plastic manufacturing

plants to see if this new material would fill our needs.

We were offered splendid co-operation throughout the reinforced plastic industry. It was generally felt that the success of our undertaking would accelerate their development by at least five years, that our failure would set them back at least that much. . .

. . . **E. J. Premo,** Chevrolet Motor Division, GMC, "The Corvette Plastic Body."

Statistical "Tools"

One of the first things we learned in setting up our statistical control system on cutting tools was that no one seemed to know how much stock should be removed for good sharpening. This was usually left to the tool grinder. He kept grinding until no evidence of prior use remained on the hob. That ground away an excessive amount of tool life.

In one plant, hob life has been increased 30% merely by controlling the amount to be removed in sharpening . . .

. . . **W. H. Seacord and F. L. Helmel,** International Harvester Co., "Statistical Control Methods as Applied to Cutting Tools."

Plant Fire Protection

All plants, however small, should organize fire squads of five or six key employees in each department. Make them on-the-job inspectors to report and correct conditions which start fires and cause accidents.

Teach them how to use extinguishers, good housekeeping, and importance of automatic sprinklers. Well-trained men will keep their heads in an emergency . . .

. . . **W. K. Ousley,** Boston Manufacturers Mutual Fire Insurance Co., "What Makes a Plant Safe?"

Gear Manufacture

Picking the right gear manufacturing process can make a big difference in the life and performance of a gear.

Take the case of a particular ring gear shrunk on a cast-iron spider. Originally, the process was to carburize and direct quench it.

By induction hardening the gear, its service life was increased 100% under full load conditions on a transmission dynamometer. And the 45,000-psi tensile stress at

These Men Led and Reported Annual Meeting Sessions

Chairmen	Secretaries
Monday	
N. R. Brownyer Timken-Detroit Axle Division, Rockwell Spring and Axle Co.	**Walter Locke** Timken-Detroit Axle Division, Rockwell Spring and Axle Co.
J. R. Almond The Midland Steel Products Co.	**T. J. Durkin** The Midland Steel Products Co.
V. A. Crosby Climax Molybdenum Co.	**James Manganello** Chrysler Corp.
J. D. Caton Monroe Auto Equipment Co.	**E. W. A. Lange** Ford Motor Co.
K. E. Coppock General Motors Corp.	**W. K. Norwick** Fisher Body Division, GMC
Tuesday	
H. L. Willett, Jr. The Willett Co.	**Henry Jennings** Fleet Owner
R. C. Wallace Diamond T Motor Car Co.	**Carl Saal** Bureau of Public Roads
M. L. Frey Allis-Chalmers Mfg. Co.	**C. T. O'Harrow** Allis-Chalmers Mfg. Co.
J. H. Dunn Aluminum Co. of America	**J. R. Long** Aluminum Co. of America
C. T. O'Harrow Allis-Chalmers Mfg. Co.	**Igor Kamlukin** Allis-Chalmers Mfg. Co.
Wednesday	
E. N. Cole Chevrolet Motor Division, GMC	**W. R. Mackenzie** Chevrolet Motor Division, GMC
P. H. Pretz Ford Motor Co.	**H. M. King** Ford Motor Co.
Paul Eddy Pratt and Whitney Aircraft	**R. F. Schwarzwalder** Wright Aeronautical Division, Curtiss-Wright Corp.
F. C. Mock Bendix Aviation Corp.	**B. J. Ryder** Bendix Aviation Corp.
Thursday	
F. A. Suess Continental Oil Co.	**E. W. Cave** Continental Oil Co.
Kenneth Boldt Pure Oil Co.	**Gilbert Way** Ethyl Corp.
G. A. Page Aeronca Mfg. Corp.	**H. A. Helstrom** Chance Vought Aircraft Division, United Aircraft Corp.
J. G. Wood New York Air Brake Co.	**Adam Hetzer** Republic Aviation Corp.
R. A. Young Hiller Helicopters, Inc.	**C. W. LeFever** Prewitt Aircraft Corp.
Bartram Kelley Bell Aircraft Corp.	**R. F. Breyer** Bell Aircraft Corp.
R. J. Woods Bell Aircraft Corp.	**R. A. Wolf** Cornell Aeronautical Laboratory
Friday	
J. W. Pennington Koppers Co.	**R. S. Frank** Caterpillar Tractor Co.
John Dickson Detroit Diesel Engine Division, GMC	**G. W. Conover** Detroit Diesel Engine Division, GMC
H. R. Boyer Cadillac Tank Division, GMC	**J. H. Murphy** Air Transport Section, GMC

a fillet (due to shrinking and straightening) was reduced 55% to 19,000 psi . . .

. . . **W. E. Gustin and D. C. Smiley**, John Deere Waterloo Tractor Works, Deere Mfg. Co., "Engineering Evaluation of Gear Manufacturing Processes."

Adhesive Bonding

Humidity does not have much effect on the adhesive strength of bonding agent FM-47, used in sandwich type construction.

In one case, a missile with a sandwich wing was flown for shipboard practice off Chincoteague, Va. A year later it reappeared in a fisherman's net off Atlantic City. The wing was returned to the company.

Samples taken from it for column compression flexure and tension testing showed good strength.

. . . **G. E. Holback and J. L. Burridge**, The Glenn L. Martin Co., "A Production Application of Structural Adhesive Bonding."

Plane Tooling

Currently we are selling three models to 29 different customers. They are the DC-6B Transport, the DC-6A Cargo, and the DC-7 Transport.

Customer configurations within these models present a challenge to our tooling and planning departments.

For example, we have to tool to build 40 different variations of floors. Since 40 different, complete sets of tools are hardly justified, we use type templates with various hole configurations . . .

. . . **J. R. Franks and C. S. Glasgow**, Douglas Aircraft Co., "Tooling and Planning Problems Related to Modern Transport Aircraft."

Airplane Producibility

Our company recently revised the design of a major component of one model after 623 units had been produced. Manpower requirements to fabricate the first unit after the change increased 625%!

The change was made to reduce production costs. But it took an additional 630 units to make up the manhours lost by making the change . . .

. . . **H. M. Harrison**, Lockheed Aircraft Co., "Over-All Problems of Producibility."

Tooling Uniformity

Aircraft engineering drawings are entirely different from those used in the automotive industry. Tooling shop personnel not familiar with them can become totally confused, even though they may have had several years experience in the automotive field.

Sometimes we have found aircraft information so involved that even the aircraft tool engineer had difficulty clarifying it . . .

. . . **Jack Slean**, Heidrich Tool and Die Corp., "Automotive Tooling Experience with Aircraft Tooling and Manufacturing."

Smooth Sailing . . .

. . . down improved highways on seats built for comfort is seen in the cards for operators of ground vehicles.

FAR from living in ivory towers, today's ground-vehicle designers and highway engineers are well aware of current user needs. This was proved beyond a doubt at several sessions.

Seating engineers, for example, know that each and every driver expects the front seat of his car to cater to his dimensions—regardless of what they are. They realize, too, that front-seat passengers are really fatigued by long trips.

Recognizing this, seat specialists have been corralling tools and ideas that can be used to improve the situation. Some of the things they've come up with, as noted at the automotive seating-comfort symposium, are:

- Oscar—a 5 ft, 9½ in., 165 lb plastic manikin that simulates his flesh-and-blood counterpart in every detail vital to seat development work. Just by designing seats to suit this dummy, seating engineers figure they can keep 80% of all men happy, it was pointed out. What's more, a "female" Oscar is in the works, one inquirer was told.
- 6-way seat adjusters—With a universal positioning seat track, **every driver could become his own seating engineer**, observed one speaker. Another chimed in with the thought that an accumulator-type closed-center hydraulic pressure system should be used to take the work out of such a seat-adjusting job.
- Hand rests for passengers—Just the thing to damp out the head and upper-torso motion a front-seat passenger now suffers, added a research specialist.

To other engineers at the meeting, better roads are the most critical need of ground-vehicle users today. Here the problem was said to boil down to a simple case of economics: How much load capacity is it worthwhile to build into pavements? Road engineers present didn't know, but they demonstrated their intention to find out.

Both the Highway Research Board and the American Association of State Highway Officials have research programs aimed at providing the answer, it was noted.

The HRB Committee on Economics of Motor Vehicle Size and Weight, for one, believes it can help solve this economic riddle by:

1. Collecting data on the cost of operating highway freight vehicles of various types, sizes, and capacities.
2. Developing a series of highway costs related to various maximum vehicle-load weights.
3. Making an estimate of the total tonnage of commodities that **could** be transported by truck in the future.

One discusser, however, questioned the need for, and value of, the last phase of this program. Conditions change too fast to make it worthwhile, he maintained, citing the case of trucking orange juice concentrate today instead of whole oranges as was

done 10 years ago. He advocated that efforts be concentrated on using the ample information already available rather than retarding action by further time-consuming research.

The AASHO, on the other hand, has a plan for conducting comprehensive load tests on specially designed road sections. This road test project, it was pointed out, could provide useful engineering information on how to predict cost data for highways of greater load capacity.

One audience participant expressed the hope that the AASHO study would also explore the possibilities of new road-building materials.

Adequate Road Equation

Only three parts need to be fitted together to solve the economic puzzle of what load capacity should be built into highways: (1) truck operation costs, (2) highway operation costs, (3) possible commodities transported by truck in the future.

Befcre these parts can be put together, however, they must be defined—a job a Highway Research Board committee has undertaken . . .

. . . **Hoy Stevens**, Bureau of Public Roads, "Economic Research in the Truck-Highway Weight Problem."

Researching Roads

The proposed AASHO Road Test Project—a plan to conduct comprehensive load tests on specially designed road sections—could produce the engineering information needed:

- To design and construct new pavements right.
- To preserve and improve existing pavements.
- As a basis for enactment of adequate and equitable truck size and weight, and taxation legislation.
- To guide vehicle manufacturers in the design of their creations . . .

. . . **A. E. Johnson**, Arkansas State Highway Department, "Comprehensive Load Test Research Critically Needed in the Highway Field."

Oscar

Trim engineers, beset with the problem of providing the utmost in seating comfort for the average man, have found a friend.

He's Oscar the dummy—a 5 ft, 9½ in., 165 lb manikin that simulates his human counterpart in every detail vital to seat development work . . .

. . . **Edwin C. Pickard**, Ford Motor Co., "The Use of 'Oscar' in Seat Design."

6-Way Seat Adjuster

A 6-way adjustable seat track would go a long way toward solving the automotive seating-comfort problem. With a universal positioning seat track, each driver would become his own seating engineer!

Besides offering a more comfortable and safer ride, such a device would open new fields for body engineers . . .

. . . **F. C. Matthaei, Jr.**, American Metal Products Co., "The Universal Positioning Seat Track."

Passenger Comfort

A front-seat passenger would be fatigued a lot less if he had some kind of hand rest. As is, the motion of his head and the upper part of his torso is almost double that of the driver. It's all attributable to the fact that the driver gets support from the steering wheel . . .

. . . **W. E. Lay**, University of Michigan, "What Happens to a Passenger When Traveling in a Car."

Hydraulic Assist

Just as electrical systems have taken many car-operating burdens off motorists, so can another type of auxiliary power system—hydraulics.

Among other things, a closed center pressure system with an accumulator could take the work out of applying and releasing parking brakes, raising and lowering windows, seat adjusting, putting convertible tops up . . .

. . . **George W. Lewis**, Electric Auto-Lite Co., "Automotive Electro-Hydraulic Power Systems."

Wheels Sub for Track?

Wheels can't always replace a track, if it is a question of getting the same flotation and traction qualities. Flotation can be produced by wide tires, but the really difficult problem—getting wheel traction without excessive slippage—can be licked only by using large diameters.

How far this is acceptable a novel calculus will say . . .

. . . **Lt.-Col. M. G. Bekker**, Johns Hopkins University, "Traction and Slippage of Caterpillars and Wheels."

Aircraft Engines . . .

. . . of three different kinds fill various needs. Each type seen having its own limitations and problems.

WITH three basically different powerplants to choose from, aircraft manufacturers must decide which of these—the reciprocating, the turboprop, or the turbojet engine—will do the best overall job.

This decision may be an easy one if, for instance, the plane is to fly at supersonic speeds, since only the turbojet is able to fill the bill in this case. Similarly, until recently, it was also obvious that the reciprocating engine had to be used in light aircraft—for turbine engines of low enough power were not available. This is no longer true, one speaker explained, for two turbine engines in the 200-hp range have been developed that might be considered for installation in small planes.

Flight tests of these engines—the Boeing 502-8 and the Continental Artouste—in a Cessna L-19 showed, he reported, that they have much to offer by way of good high-altitude performance and

Around the Meeting . . . .

"Statistics are something like a Bikini bathing suit," noted Hoy Stevens at one technical session. "What they reveal is interesting; what they conceal is vital."

Classic proof of the efficiency of the Sheraton-Cadillac house boys: One minute after T&B business session got underway, "Henry" shuffled up to the blackboard and had half of it erased before the nominating committee had even been nominated!

The Scriptures best describe Bill Holaday's revised ideas on how high fuel octane number can go, observed Darl Caris at a passenger-car session. To wit, "And it came to pass that the people that walked in darkness have seen a great light. They that dwelt in the shadow upon them hath the light shined."

Upsonisms: According to Bill Upson, creator of the Alexander Botts Earthworm tractor stories, American business gets a higher type of discipline from its employees. It consists of not obeying the order the boss gave you, but the order he would have given you if he knew what he were talking about. . . . A prospect is a man on whom you are about to unload something. Afterward he is known as the "owner" or "victim."

Mechanical Brain: Jack Slean of Heidrich Tool told of the engineer at the Akron bus terminal who had bought a ticket to Cleveland. While waiting for his bus, he put a nickel in a scale and weighed himself. Out came a card which said, "You are six feet tall, have blond hair, and have a ticket to Cleveland in your pocket." His curiosity aroused, he put in another nickel and out came a card with exactly the same message.

This time he examined the machine carefully, then mussed up his hair, twisted his hat, and again stepped up on the scale and put in a nickel. Out came a card which said, "You are six feet tall, have blond hair, have a ticket to Cleveland in your pocket. And if you hadn't horsed around here so long, you wouldn't have missed that bus to Cleveland."

Then there was the Irvin Cobb story told in connection with gripes about paper work in industry. An Army colonel complained to Cobb of military red tape, and surmised that it must always have been that way. Cobb differed with him and told of a Confederate army document still extant. It's a letter from a Confederate army captain to Gen. Nathan Bedford Forest (who coined the phrase about getting there fustest with the mostest) asking for leave. On the back was written Gen. Forest's reply: "I done told you twice before. No, dammit, no!"

"Gozinta charts are quite popular in Lockheed's production planning and scheduling operations," said Harold Harrison. When asked to describe a Gozinta chart, he replied: "Oh, that's merely a production flow chart which shows that this part goes into that subassembly and that subassembly goes into this main assembly."

simplicity of operation. Unfortunately, he continued, fuel consumption was much too high to consider them for most light-aircraft applications.

In the transport field, the reciprocating engine is still very much alive—and one development reported as helping to keep it so is the turbine compound engine. When blowdown turbines are used —as in the Wright Turbo Compound 18-cyl aircooled radial engine—there is an 18% increase in the take-off bhp and 10% increase in the cruise power at sea level, with even higher percentages reported for operation at critical altitude. As a result, the already low specific fuel consumption of this engine has been improved even more.

Even though this engine is in competition with turboprop and turbojet engines of higher equivalent ratings and better power/weight ratios, its builders feel that it is attractive for future applications up to speeds of 450 mph. They do not expect the piston engine to become extinct within the next 10 years, in view of the overall costs, fuel consumption, high initial cost, and inherent operating problems of turbine-powered aircraft.

Two of the difficulties of turbine engines and their operation discussed at the meeting were:

1. High temperatures.
2. Controls.

For instance, when turbojets are flown in the Mach 2–3 range, high engine temperatures will be just as serious as the already highly publicized high aircraft skin temperatures. Not all these temperature problems will be metallurgical, either, it was explained.

There will be the fire hazard from fuel and lube oil. For example, the temperature of the high-pressure end of the compressor casing is above the ignition points of most hydrocarbon fuels and oils. The engine firewall must thus become a duct to bring fuel and lube lines to the engine. Pneumatic systems may take the place of hydraulic mechanisms because of the cooling problem. In addition, means of cooling the electrical system will have to be devised. It may even be desirable to put engine accessories in a separate, insulated and cooled compartment.

As far as turbo-engine controls are concerned, the primary need of the pilot was said to be sim-

plicity—operation as completely automatic as possible, combined with maximum reliability. The pilot of a plane only a few hundred feet from the ground or other planes has no time to think, with disaster distant by a matter of seconds or less. Thus, there must be no complications that tend to confuse or delay recognition of an emergency, or that could delay pilot reaction after recognition of the emergency.

Recommended for turbojets was a simple, basic control system, capable of safely operating the engine throughout the full range of throttle lever travel, and capable of trimming to obtain maximum performance in military and afterburning power settings. Engine rpm is controlled by governing fuel flow, and engine temperature is controlled through the exhaust nozzle area. The two systems are interlocked by a linkage to the common pilot throttle lever.

Supersonic Flight

In the supersonic speed ranges, the turbojet engine is very efficient, contrary to general opinion. Flying supersonically, it has thermal efficiencies equal to or better than the maximum obtained with diesel engines or central-station steam power systems.

The rate of fuel consumption is high because of the large power requirements needed for flying at high speeds . . .

. . . **Joseph S. Alford and Earl L. Auyer**, Aircraft Gas Turbine Division, General Electric Co., "Turbojet-Engine Design Problems for Supersonic Flight."

Turbojet Controls

The pilot of military jet aircraft is far too busy to be able to concentrate more than a small percentage of his time on engine details.

In so far as possible, controlling mechanisms must be simple and straightforward.

In no case should the pilot be required to analyze or think through an emergency. Not that the average pilot cannot think, but when only a few hundred feet from the ground or other planes, disaster is a matter of seconds or less . . .

Continued on Page 68

. . . . Around the Meeting

Aesop's Fable: According to W. K. Ousley, a theatrical promoter recently heard of a spectacular Basque tumbling team. He journeyed all the way to Spain to sell these four tumblers on coming to New York for lucrative TV and night club appearances. At first the tumblers were disinterested. But after considerable cajoling and conniving with these men, the town mayor, and their priest, the promoter won out.

One of the first things to catch their fancy in New York was a revolving door. So round and round the four Basque tumblers spun in it, until one tripped, and fractured his arm. That broke up the act.

Moral to the story: Don't put all your Basques in one exit.

Overheard between sessions:
Engine Designer: Why do they make such a fuss over Marilyn Monroe? She's just a member of the female sex.
Petroleum Technologist: She's not just a member. She's the president!

The American Helicopter Society co-sponsored the two-session symposium on helicopter fatigue problems held Thursday, Jan. 14. AHS President Charles W. LeFever of Prewitt Aircraft represented AHS officially and also took over the session secretary's duties in the absence of the scheduled secretary.

The three experts on Bartram Kelley's helicopter fatigue research panel weren't stumped once all afternoon long. They were
Sam Gordon of Battelle Memorial Institute
Paul Kuhn of the National Advisory Committee for Aeronautics
Capt. Paul Simmons of the Propeller Laboratory at Wright Air Development Center

Flying single-engine aircraft in instrument weather over metropolitan areas is strictly for the birds, said Herbert O. Fisher of the Port of New York Authority in talking with a covey of light aircraft enthusiasts. The possibility of engine failure endangers other aircraft in the vicinity and the millions of people on the ground.

Commenting on the fact that Carl Georgi spilled ice water on himself while presenting his paper, Carl Tongberg noted: "In the past we've known people to throw cold water on some of Carl's presentations, but this is the first time he has done it himself!"

Carl Jakust told of his boss' (Ed Cole, chief engineer of Chevrolet) field-test experience with a prototype plastic-body Corvette. Seems Ed took one of the first models out on a rainy day and soon found water ran in around the doors—and didn't run out. The moisture fast steamed up the windows . . . so Ed reached into the storage compartment in the door for a rag. There, he found the water was even deeper than on the floor. And to top it off, his camera was completely submerged in it!

When the audience roared at the punchline, Carl quipped, "I must have told this story better than 'the boss' did 'cause nobody laughed when he told it to us."

Exhibitors at the

Aeroquip Corp.

Aluminum Co. of America

Aluminum Industries, Inc.

American Bosch Corp.

Anchor Coupling Co. Inc.

Automotive & Marine Products Corp.

Automotive Rubber Co., Inc.

Auto Specialties Mfg. Co.

Bendix Aviation Corp.
- Bendix Products Division
- Bendix Skinner Division
- Eclipse-Machine Division
- Scintilla Magneto Division

Bohn Aluminum & Brass Co.

Brush Electronics Co.

Buda Co.

Campbell, Wyant & Cannon Foundry Co.

Cities Service Petroleum, Inc.

Cleveland Graphite Bronze Co.

Consolidated Engineering Corp.

Continental Motors Corp.

Cummins Engine Co., Inc.

Detroit Aluminum & Brass Corp.

Dualoc Drive, Inc.

E. I. duPont de Nemours & Co.

Flex-O-Tube Division, Meridan Corp.

Fram Corp.

Fulton Sylphon Division, Robertshaw-Fulton Controls Co.

Garlock Packing Co.

Gemmer Mfg. Co.

General Plate Division, Metals & Controls Corp.

Goodyear Aircraft Corp.

Groov-Pin Corp.

Heli-Coil Corp.

Hercules Motors Corp.

Hughes Aircraft Co.

Johnson Bronze Company

Engineering Display

Kelsey-Hayes Wheel Co.

Koppers Co., Inc.

Leece-Neville Co.

LeRoi Co.

Link Engineering Co.

Lisle Corp.

Lord Mfg. Co.

MB Mfg. Co., Inc.

McQuay-Norris Mfg. Co.

Monroe Auto Equipment Co.

Motor Products Corp.

Novi Equipment Co.

Oil Hydraulic Division, Webster Electric Co.

Perfection Stove Co.

Pierce Governor Co., Inc.

Redmond Co., Inc.

Rosan Inc.

Ross Gear & Tool Co.

Schwitzer-Cummins Co.

Sparton Automotive Division, Sparks-Withington Co.

Spencer Thermostat Division, Metals & Controls Corp.

Spicer Mfg. Division, Dana Corp.

S. Sterling Co.
(for Allen B. DuMont Laboratories)

Stewart-Warner Corp.

Sun Electric Corp.

Titeflex, Inc.

Torrington Mfg. Co.

Vickers Inc.

Victor Mfg. & Gasket Co.

Waldes-Kohinoor, Inc.

Wallace & Tiernan Co. Inc.

Waukesha Motor Co.

Wayne Engineering Research Institute

Zollner Machine Works

continued from page 65

. . . **Robert E. LaCroix,** Aviation Gas Turbine Division, Westinghouse Electric Corp., "A Pilot's Viewpoint of Turbojet Control Requirements."

Small Turboengines

Since the war two turbine engines have been developed that the manufacturer of small aircraft might consider for use in place of the reciprocating engine.

With special provision for ground starting and the addition of more fuel-tank capacity to give adequate range, airplanes with these engines are practical today.

When one considers the extra fuel consumption with the same performance, it is obvious, however, that there is no real need for these engines on small aircraft unless a special high-altitude, high-cruising requirement exists . . .

. . . **J. H. Gerteis,** Cessna Aircraft Co., "Light Aircraft Turbopropeller Installations."

Turboprop Noise

From a noise standpoint the turboprop powerplant presents a different problem than either the turbojet or reciprocating engine. The high rotational speeds required by the turboprop to operate at near zero net horsepowers result in the same high rotational speeds for the propeller.

Theory and measurements showed that 90% of the noise intensity generated was from the propeller . . .

. . . **D. J. Nolan,** Allison Division, GMC, "Practical Problems of Turboprop Controls."

Piston Engines

Future prophets predicting the demise of the reciprocating engine should take note that present prophets have not been too successful.

When one considers the overall costs, fuel consumption, and high initial cost of turbine-powered aircraft and the inherent operating problems, it is difficult to conceive that the piston-engine transport will become an extinct species within the next 10 years . . .

. . . **F. J. Wiegand and W. R. Eichberg,** Wright Aeronautical Division, Curtiss-Wright Corp., "Development of the Turbo Compound Engine."

Exhaust Systems

Apparatus has been devised for testing exhaust systems at sea level under the conditions of gas flow, temperature, pressure differential, and vibration encountered at high altitude in large aircraft.

This equipment was unusually successful in forecasting and eliminating faults in exhaust systems that would have been extremely unwelcome in flight.

The test was apparently severe, though accurate, for systems that were corrected to survive 500 hr of ground testing have uniformly exhibited the ability to withstand 500–1000 hr of flight service . . .

. . . **C. F. Derbyshire,** Rohr Aircraft Corp., "Simulated Altitude Tests of Large Aircraft-Engine Exhaust Systems."

Commercial Vehicle Brakes . . .

. . . don't need to be pampered, but they can't be neglected. Secret is to follow certain basic brake maintenance rules.

"GIVE brakes a break and you'll give yourself one too," fleet operators at one session were told. It's not necessary to pamper commercial vehicle brakes. But it is important to follow—not break—certain basic brake maintenance rules.

Don't try to maintain a braking system at its full original efficiency and performance, was one bit of advice passed out. Instead, decide upon the minimum permissible deterioration from a safety standpoint, then stick within it! The important thing here, it was said, is to make sure that the brakes are big enough to begin with. If they're too small for the type of service imposed, then it's impossible to follow this rule. In such a case, the brakes must be maintained at full efficiency for safety's sake.

To another expert, one thing to remember is that cheap brake fluids are no bargain. "The dozens of so-called brake fluids marketed today with 180 F (and lower) boiling points are a real menace," he warned. The heat generated by severe braking can cause these low-boiling point fluids to vaporize completely—with dire results.

There's a right and wrong way to counteract the tendency of trailer electric brakes to act faster than tractor air brakes, chimed in a third engineer. The right way to maintain synchronization: Keep tractor brakes in top operating condition. The wrong way: Try to compensate for faulty tractor brakes by making adjustments in the electric-brake actuating mechanism.

Setting up a good brake balancing program can pay big dividends too, someone else noted. Besides improving braking performance, it can also increase bearing, lining, and tire mileage; reduce drum checking and scoring; minimize squeal; and decrease costly breakdowns.

Maintain 75% Efficiency

It isn't practical to try to maintain a commercial vehicle braking system at its full original performance and efficiency. The thing that's important is to establish permissible deterioration from a safety standpoint (usually about 25%), then keep within it! . . .

. . . **R. K. Super,** Timken-Detroit Axle Division, Rockwell Spring and Axle Co., "Basic Maintenance Requirements for Brakes for Commercial Vehicles."

Brake Adjustment

It is best to adjust brakes with the vehicle jacked up . . . and to check for a free wheel after the adjustment has been made. This will eliminate the chance of a dragging brake due to out-of-round drums. . .

. . . **R. A. Goepfrich,** Bendix Products Division, Bendix Aviation Corp., "Brake Maintenance Pays."

Synchronizing Brakes

Before attempting to balance electric trailer brakes with tractor air brakes, make sure the tractor air system (including brakes) is operating at peak performance.

When an air assist is used with hydraulic tractor brakes, a hydraulic-electric controller should get the nod over an air-electric one . . .

. . . **F. C. Hile**, Automotive Division, Warner Electric Brake & Clutch Co., "Coordination of Electric with Other Braking Systems."

Brake Drums

Both drums on any one axle should be of the same size and make.

Drums should never be machined to more than 0.310 in. beyond original diameter.

New or turned drums should be coated with a light film of oil to prevent corrosion while in storage . . .

. . . **R. H. Moore**, Conestoga Transportation Co., "Heavy Duty Brake Maintenance and Brake Balancing Procedures."

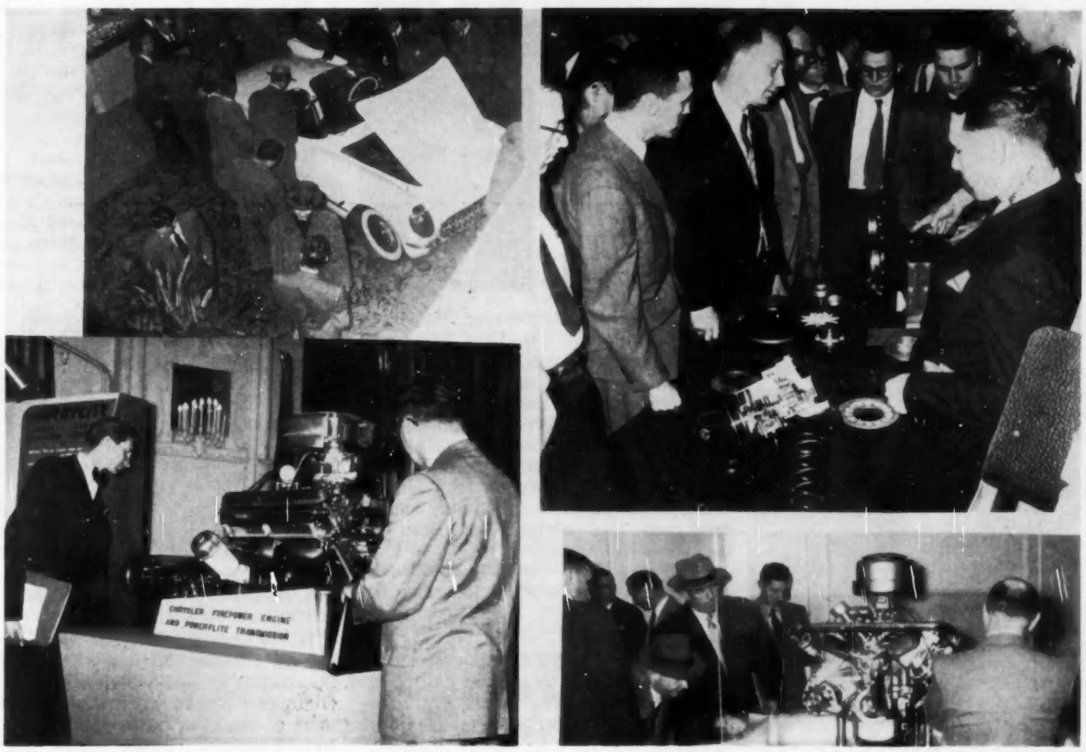
Cutting Stopping Distance

There's only one way left to decrease stopping distance of truck-trailer combinations with air brakes: cut air application time.

Reducing air transmission time from 0.4 to 0.2 sec would, under ideal conditions, decrease stopping distance 7.1% (2.93 ft) from a speed of 20 mph. And tests show that it is possible to make gains in this direction . . .

. . . **Stephen Johnson, Jr.**, Bendix-Westinghouse Automotive Air Brake Co., "Pneumatic Aspects of Brake Balancing."

New Products Paraded for Inspection . . .



Whether they looked then listened or listened then looked, engineers at the meeting gave lots of attention to displays of new products described in technical papers. On exhibit were the Chevrolet Corvette (upper left), McCulloch automotive centrifugal supercharger (upper right), Chrysler PowerFlite transmission (lower left), and Ford V-8 engine (lower right)

About SAE


Martin


Carpenter

J. E. MARTIN has been elected president of the Dana Corp., Toledo, Ohio. Martin joined the company in 1952 and has been executive vice-president. He succeeds **RALPH E. CARPENTER**, who has been president since 1948. Carpenter has been elected vice-chairman of the board, a newly-created position.

CHARLES E. HEITMAN, Jr., manager of the Automotive Division of the A. O. Smith Corp., Milwaukee, has been named to fill the newly-created post of assistant to the general manager of the company.

HENRY L. GASBARE is now a testing engineer with the Bendix-Westinghouse Automotive Air Brake Co., Elyria, Ohio. He formerly worked for the Mack Truck Co. in Plainfield, N. J.

ROY R. BORLAND is now with the Continental Motors Co., Detroit. He was formerly with the Ford Motor Co. of Canada, Ltd., Windsor, Ontario, as a design draftsman.

J. L. CHILTON is chief development engineer for the Hupp Corp. in Detroit. He was previously chief electrical engineer for ACF-Brill Motors Co. in Philadelphia.

CHARLES P. DeVOSS has been appointed manufacturing manager of the Special Product Division of Ford Motor Co. DeVoss was manager of manufacturing planning of Special Product Operations, forerunner of the recently established division.


DeVoss


Davis

FRANCIS H. DAVIS has been elected vice-president in charge of sales, Ross Gear and Tool Co., Lafayette, Indiana. He was previously sales manager for the company. He succeeds **S. L. BRADLEY** who has retired after 36 years of service.

WILLIAM M. MURRAY has been promoted to vice-president, direct sales, of Deep Rock Oil Corp., Tulsa, Okla. He will supervise the bulk sales of the general line of refined products, lubricating oils, waxes, naphthas, fuels and specialties. As new products are developed by the company's research department, they will also be Murray's sales responsibility. He was formerly manager of general product sales.

Working with Murray is **LEHMAN H. SULLIVAN** manager of the lubricating oil sales department. Sullivan was previously assistant manager of the department.


Murray


Prior

L. S. PRIOR has been appointed aviation consultant and distributor of aviation products for Winslow Engineering Co. in the Western states and Texas. His headquarters will be in the company's Oakland, Calif., offices. He will travel throughout the United States to consult with engine manufacturers and airline engineers on filtration problems.

Prior was production superintendent for the Oakland Aircraft Engineering Service.

RALPH W. GOETZ is now president of Winner Oil Products Co., Milwaukee. Goetz was previously assistant sales manager of Perfex Corp., Milwaukee.

JOHN P. LORD is now a sales representative for the Allison Division, GMC, Indianapolis. He was previously a supervisor of commercial sales for Allison.

T. A. WELLS has formed the Central Engineering Corp. in Wichita, Kansas, to handle engineering, manufacturing, and development of various products. The first product will be an installation of a weighing mechanism on fork-lift trucks to weigh accurately the load carried on the forks. Wells was previously vice-president and chief engineer of Beech Aircraft Corp., Wichita.

RAY P. DINSMORE has been elected a director of the American Institute of Chemical Engineers to serve for a three year term. Dinsmore is vice-president in charge of research and development, The Goodyear Tire & Rubber Co., Akron, Ohio.

HOWARD E. ELDEN has been elected vice-president in charge of manufacturing, research and development of the Dunlop Tire and Rubber Corp., Buffalo, N. Y. Elden, who joined Dunlop 30 years ago, was placed in charge of research and development in 1950.


Elden


Lowther

W. W. LOWTHER has now joined the Air Cleaner Division of the United Specialties Co. of Chicago as a sales engineer. He was formerly vice-president of engineering and sales, Crenle, Inc., Rochester, Minn.

ALFRED G. GORSKI has joined Alloy Engineering & Casting Co., Champaign, Ill., as a project engineer. Gorski was assistant chief draftsman for Redmond Co., Inc., Owosso, Mich.

Members . . .

D. FRANKLIN BOYD, previously chief estimator in the budget department of Kaiser Motors Corp., Willow Run, Mich., is now staff assistant to the vice-president of Kaiser Motors in Toledo.

J. E. MICKSCH has joined the Rockwell Spring & Axle Co., Ashtabula, Ohio, as a research engineer. He was formerly with Lake City Malleable, Inc. in Ashtabula as a research engineer.

JOHN F. JONES, formerly a design supervisor for Chrysler Corp.'s Tank Engine Division, is now a project engineer in the body structures lab, Central Engineering Division, Chrysler Corp., Detroit.

N. F. ADAMSON, vice-president of sales for the Twin Disc Clutch Co., Racine, Wis., has been elected to the board of directors of the company.

Adamson

Gibbons

LEO I. GIBBONS has received his 40-year service award from the B. F. Goodrich Co. He is manager of the automotive section, Field Engineering Tire Division. Gibbons joined the company in 1913 after he graduated from Ohio Wesleyan University. He has been a member of SAE for over 25 years and has served on several committees of the Detroit Section.

R. J. OSTRANDER, former supervisor of motor vehicle operations at Ethyl Corp.'s research and engineering laboratories, Detroit, has been promoted to assistant director of technical service.

WINTHROP A. JOHNS, president of Johns Mfg. Co., recently announced the introduction of the Magna Power acid neutralizer, a crankcase drain plug that is said to neutralize crankcase oil acids. The drain plug is fitted with a rod of magnesium alloy. As acids are formed, they neutralize themselves by attacking the magnesium rod in preference to other engine parts, says Johns. The Magna Power plug is priced at $2.95.

Johns

Smith

W. WAITS SMITH has been named manager of the Aviation Gas Turbine Division of Westinghouse Electric Corp. In his new post, Smith will be in charge of all phases of jet aircraft engine development at the Kansas City, Mo., and South Philadelphia, Pa., plants of Westinghouse. He was previously chief administrative engineer for both gas turbine contracts and the Automotive Division of the Studebaker Corp.

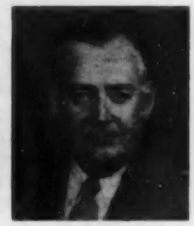
THEODORE KENSETT ROSSITER is a service representative and instructor for Ford Motor Co., Teterboro, N. J. He was a test engineer in the research laboratory of Mack Mfg. Co., Plainfield, N. J.

J. C. WIDMAN has been named to head Ford Motor Co.'s new special projects group for research in advanced body design.

FRANK H. ERDMAN is now executive secretary of Experiment, Inc., Richmond, Va. Erdman was formerly assistant to the president of McDonnell Aircraft Corp., St. Louis, Mo.

WALTER G. BAIN, executive assistant to the president of Republic Aviation Corp., has been elected a vice-president by Republic's board of directors. Bain was previously with the U. S. Air Force in which he held the rank of major general.

Bain



Creamer

JOHN F. CREAMER, a director of the Motor & Equipment Wholesalers Association, was elected vice-president at the annual meeting of that association in Chicago, last December 10. The organization is made up of 1500 automotive parts jobbers in the United States.

Also a director of the Greater New York Safety Council, Creamer has been re-elected a vice-president of that organization.

He is treasurer and chairman of the board of Wheels, Inc., New York, and was chairman of the Metropolitan Section in 1931-32.

RAYMOND I. POTTER, former chairman of the Cleveland Section of the Society of Automotive Engineers, participated in the recent Management Problems for Executives course at the University of Pittsburgh. Potter is chief of the Lubricants & Fuels Service Division, The Standard Oil Co., Cleveland.

JOHN A. SWINT has been appointed manager of Ford Motor Co.'s Livonia plant which is being converted from production of M-48 tanks. Pilot production is under way on transmissions. Swint was chief engineer of the Tank Division.

Swint

McGraw

WILLIAM McGRAW has moved to the staff of the president and general manager of Chrysler Corp. of Canada. He was previously chief engineer of Chrysler Corp. of Canada. He is a past-chairman of the Canadian Section and was a Councilor for 1939-40.

Rockwell Joins Acro Mfg.

WALTER F. ROCKWELL is now chairman of the board of Acro Manufacturing Co., manufacturers of precision switches, temperature controls, and fractional horsepower specialty gear motors. The company's national headquarters will remain in Columbus, Ohio, but Rockwell will maintain additional offices in Detroit.

The announcement came late in December, shortly after Rockwell's return from a two-months European trip. Last Fall, he had retired as president of Timken-Detroit Axle Co. after 35 years of service with that organization. Rockwell is an engineering graduate of Tufts College and started his career as a service engineer. Later he became purchasing agent and ultimately general manager of Wisconsin Axle Co., continuing in that capacity when that company became a division of Timken-Detroit Axle. He continues to be a member of the SAE Finance Committee.

MARSHALL J. CORBETT has joined Thompson Products, Inc., Cleveland, as a research engineer. Corbett was formerly a propulsion engineer with the Grumman Aircraft Engineering Corp., Bethpage, N. Y.

DUANE C. ECKSTEDT has become a design engineer for the Food Machinery and Chemical Corp., San Jose, Calif. Eckstedt was a product designer for Martin Motors, Division of National Presto Industries, in Eau Claire, Wis.

EARLE W. CHESNUTT is with the Fairchild Aircraft Division, Fairchild Engine & Airplane Corp., Hagerstown, Md. He was previously a project engineer for United Aircraft Products, Inc., Dayton, Ohio.

ALOIS H. SCHMAL has joined the Detroit Gear Division of the Borg-Warner Corp., Detroit, as chief engineer. Schmal was executive engineer heading the Transmission and Rear Axle Division of Mack Mfg. Corp., Plainfield, N. J.

JOHN T. RICHARDS, formerly a development engineer with The Beryllium Corp., was recently named president and chief engineer of Penn Precision Products, Inc., Reading, Pa., producers of precision-rolled beryllium copper strip.

CHRISTOPHER G. MacDERMOT has returned to The Franklin Technical Institute in Boston as an instructor in the automotive department. His work at Franklin was interrupted while he served in the Army Chemical Corps. MacDermot was the New England Section's field editor in 1951.

LOUIS C. WOLFF has joined Meeks Motor Freight, Inc., Louisville, Ky., as operations manager. He was previously assistant vice-president of operations for Roadway Express, Inc., Akron, Ohio.

DR. ROSS A. McFARLAND, associate professor of industrial hygiene, Harvard School of Public Health, Boston, has received an award for his book, "Human Factors in Air Transportation." The award is one presented annually by the Flight Safety Foundation, Inc., New York, for "Achievement in Safer Utilization of Aircraft." The award was presented to McFarland by **JEROME LEDERER**, managing director of the Foundation.

A. R. FICKER has been appointed director of advanced engineering for the Rockford Clutch Division of the Borg-Warner Corp. at Rockford, Ill. He was recently associated with Chicago Midway Laboratories, Division of the University of Chicago, as acting chief engineer and consulting engineer on a special Air Force project.

L. F. FISHER is now a research engineer with the Boeing Airplane Co. in Seattle, Wash. He was formerly with the Austin Co., East Cleveland, Ohio.

A. T. COLWELL presented the keynote speech to the Ramsey Corp.'s sales conference, January 4-8, at the Hotel Sheraton in St. Louis. His address, "A Look into the Future," stressed the value of research on present automotive products to make them a better buy for the motoring public, to make automobile operation and maintenance less expensive, and to help reduce some of the motoring hazards.

LaVERNE N. GUSHARD, assistant chief of the Japan Procurement Agency's Tokyo District Office, was chairman of the JPA's Standardization Committee meetings held last January 25 and 26 in Tokyo. The Committee's purpose is to insure greater uniformity in inspection and administrative procedures.

JOHN G. HOLMSTROM, vice-president and general manager of Kenworth Motor Truck Corp., recently announced the introduction by his company of a cab-beside-engine design. The truck (shown above) features greatly improved visibility. There is a tandem seat behind the driver for a rider. Other advantages claimed for the truck are easier access to the engine, lower maintenance costs, and more comfortable riding qualities. And the smaller cab is said to reduce weight while increasing strength.

WALTER E. JOMINY, Chrysler Corp., is chairman of the committee which organized a symposium on Utilization of Heat-Resistant Alloys, to be presented at the University of Michigan, March 11–12. The symposium is to honor Prof. A. E. White on the occasion of his retirement as head of the Engineering Research Institute. Other SAE members participating are: **A. W. F. GREEN** of GMC's Allison Division, **A. L. BOEGHOLD** of GMC and **A. J. HERZIG** of Climax Molybdenum Co. Green will present a paper, "Development of and Acceptance-Testing procedures against Specifications for Heat-Resistant Materials." Boegehold and Herzig will be chairmen of technical sessions to be held.

Jominy

Cunningham

EDWARD N. CUNNINGHAM has been promoted to sales manager of Precision Rubber Products Corp., Dayton, Ohio. Cunningham was assistant sales manager.

ARTHUR J. WELCH, sales manager of the Spring Division, Borg-Warner Corp., Chicago, has become a vice-president of the division.

L. E. DURKEE is with the Socony Vacuum Oil Co., St. Louis, as an industrial salesman. Durkee was previously a lubrication engineer for Socony.

MARTIN SHERMAN BLACKMAN has joined the General Electric Co. in Utica, N. Y., as a product design engineer. He was previously with North American Aviation, Downey, Calif., doing structural test work.

C. W. TRUXELL, JR. is now director of engineering and manufacturing for Aeroproducts Operations, Allison Division, GMC, Dayton, Ohio. He was director of sales and engineering for GMC's Diesel Equipment Division.

HOLLIS W. SMITH, formerly an industrial salesman for Humble Oil and Refining Co., Dallas, is now with George J. Fix Co., Dallas, as a sales engineer.

WILLIAM T. ODUM has become a design engineer "C" with the Hayes Aircraft Corp., Birmingham, Ala. Odum was a senior experimental engineer with Harley-Davidson Motor Co., Milwaukee.

FORREST N. GAFFIN is now president and general manager of F. Gaffin, Inc., Oklahoma City. The company operates a refrigerated truckline, hauling meat and dairy products. Gaffin was sales engineer for The Fruehauf Trailer Co. in Oklahoma City.

JOHN F. MURPHY, formerly a product engineer with the Eclipse Machine Division of Bendix Aviation Corp., Elmira, N. Y., is now experimental engineering superintendent at the Metals Processing Division, Curtiss-Wright Corp., Buffalo. Murphy was vice-chairman of SAE's Syracuse Section for 1951–52.

MERION YOUNG is now manager of Automotive Equipment Co.'s Portland, Oregon, branch. Young was assistant district manager for the International Harvester Co. in Portland.

H. F. CAPLETT is a senior manufacturing engineer with North American Aviation, Inc., Downey, Calif. Caplett was previously with the Aircraft Engine Division of Ford Motor Co. as a supervisor of assembly and test methods, layout and material handling.

RUSSELL S. JOHNSON has been appointed director of sales of the Eclipse Machine Division of Bendix Aviation Corp. Johnson will be responsible for sales, service and advertising activities of the Division. Previously he was manager of automotive products sales for the Division. His new headquarters is in Elmira, N. Y.

JOHN M. CAMPBELL, administrative director of the General Motors Research Laboratories, is chairman of a new technical study group to investigate possible effects of automotive exhaust gases on air pollution. The group is a subcommittee of the Automobile Manufacturers Association's Engineering Advisory Committee.

HERMAN H. MESICK is now divisional manager of trucks in New York for the Dodge Bros. Corp., Detroit. He was assistant regional manager, Portland, Oregon, for Dodge Bros.

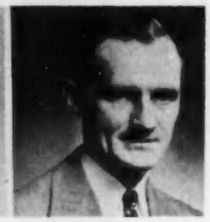
CARL P. NOTTINGHAM, formerly a draftsman at Mack Mfg. Co., Allentown, Pa., is now with The Sperry Corp., New Holland Machine Division, as a drawing checker in the special services department.

J. E. DeREMER has announced the change of name of the Smith-Morris Co. to the Smith-Morris Corp., Ferndale, Mich. DeRemer is vice-president and chief engineer of the company.

E. O. MARTINSON, formerly vice-president in charge of engineering for the Koehring Co., Milwaukee, is now president and general manager of Waterous, Ltd., Brantford, Ontario.

E. D. KEMBLE has been appointed organizational consultant with the Management Consultation Services Division, of the General Electric Co. He was manufacturing manager of GE's Air Conditioning Division. Kemble is SAE Vice President for Production. In 1953, he was meetings vice-chairman of the Production Activity Committee.

Kemble



Brennan

JOHN E. BRENNAN has been appointed general manager of Chrysler Corp.'s new Automotive Body Division. The Division consists of the principal automotive plants, machinery and equipment that have been purchased from the Briggs Mfg. Co. The body building facilities acquired are to be used for the entire output of Plymouth cars.

W. H. BERNARD is a sales engineer for The Anderson Co., Detroit. He was formerly chief engineer of Teleflex, Inc., North Wales, Pa.

DUDLEY D. FULLER has been appointed to the staff of the Mechanical Engineering Division, of The Franklin Institute's laboratories for research and development. As principal scientist in this Division, Fuller will be in charge of the Friction and Lubrication Section. He will also continue on the staff at Columbia University, where he is associate professor of mechanical engineering.

Sherman

THOMAS L. SHERMAN has accepted a consulting assignment with Battelle Institute, Columbus, Ohio. Sherman, who is noted particularly for his work in the development of high-performance diesel engines, will work with Battelle's Mechanical Engineering Division. Prior to accepting the Battelle assignment, he was employed as a consulting engineer by the Fairbanks-Morse Co.

New Titanium Plant

V. P. RUMELY, vice-president in charge of manufacturing for the Crane Co. in Chicago is shown breaking ground for a new $25,000,000 titanium plant at Chattanooga. The plant will be operated by Cramet, a wholly-owned subsidiary of the Crane Co. It is scheduled to be in first production January 1, 1955, and in full 6,000 tons/year production July 1, 1955.

Rumely is a past SAE vice-president of production.

H. R. LEWIS, chief metallurgist of Ohio Seamless Tube Division of Copperweld Steel Co., culminated 45 successful years with the steel industry on January 1. For 35 years he had been associated with the Ohio Seamless Tube Co. Highlight of his career was the adoption of Chrome-Moly (4130-X) to steel tubing principally used for aircraft—an achievement in which he played a leading role.

ALEXANDER R. ANDRE is now assistant chief engineer of the Forage Division of Cockshutt Farm Equipment, Ltd., Brantford, Ontario, Canada. He was previously chief engineer of Cockshutt Farm Equipment, Inc., Bellevue, Ohio.

W. H. C. WHITE is now an automotive service engineer and supervisor of motor transportation for the Sun Oil Co., Ltd., Toronto, Ontario. He was previously in the inspection department of General Motors of Canada, Ltd., Oshawa, Ontario.

ROBERT JOSEPH MILLER is now a test engineer for Pratt & Whitney Aircraft, East Hartford, Conn. Miller was previously a naval aviator in the United States Marine Corps.

DONALD A. VOORHIES is with C. V. Hill & Co., Inc., Trenton, N. J., as a director of engineering. He was formerly chief engineer for the Hussman Refrigerator Co. in St. Louis, Mo.

JAMES G. WEAVER, formerly a project engineer for the Detroit Arsenal, Army Ordnance Department in Centerline, Mich., is now with the Houdaille-Hershey Corp.'s Research & Engineering Division, Highland Park, Mich. He is a senior product engineer.

Students Enter Industry . . .

JAMES R. GRIFFITH (Yale University '53) has joined the United Shoe Machinery Corp., Beverly, Mass. He is employed as a project engineer.

GEORGE C. KOURIS (University of Southern California '53) is a development engineer with the Goodyear Tire & Rubber Co., Los Angeles, California.

WILLIAM C. SCOTT (Penn State College '53) is with the General Electric Co. of Evandale, Ohio. He is working on a test engineering program.

CLARENCE E. YOUNGMAN (Parks College '51) is a liaison engineer for the Goodyear Aircraft Corp., Akron, Ohio.

RAYMOND MORRIS COLE (Penn State '54) has been employed as a junior engineer by the General Motors Research Laboratories, Warren, Michigan.

WALTER JAMES EAGER, JR. (California Institute of Technology '53) is a junior design engineer with the Foods Machinery & Chemical Corp., San Jose, Calif.

JEROME LIEBOW (University of Michigan '53) has joined the Packard Motor Car Co., Detroit. He is a junior detailer.

E. A. HEMPEL (Stevens Institute of Technology, '53) has become a member of the Armed Forces. He is a second lieutenant in the U.S.A.F.

CARL A. VESPERMAN, JR. (General Motors Institute '53) has left his position with Chevrolet-Tonawanda to enter the Armed Forces.

HERBERT W. BEHLOW (General Motors Institute) is attending Officers Candidate School at Fort Benning, Ga.

RAYMOND E. ALDEN (University of Miami '53) is now a design engineer for the Worcester Automatic Rebuilding Co., Worcester, Mass.

CARL A. VESPERMAN, JR. (General Motors Institute '53) is serving with the U. S. Army.

ANTHONY FORTINI (Purdue '53) is an aeronautical research scientist for the National Advisory Committee for Aeronautics, Cleveland.

E. A. HEMPEL (Stevens Institute of Technology '53) is a second lieutenant in the U. S. Air Force Reserve.

CHARLES WESLEY SCHWARTZ (Ohio State University '53) has joined the Ford Motor Co., Dearborn, Mich. He is a product test engineer in the vehicles testing department.

JOHN GEOFFREY TROTTER (University of Saskatchewan '53) is now company engineer for the Saskatoon Fire Engine Co., Ltd., Saskatoon, Saskatchewan, Canada.

WILLIAM B. WHITE (California State Polytechnic College '53) is a technical trainee with the Union Oil Co. of California, Los Angeles.

RICHARD H. SMITH (Oregon State College '53) has been employed as a tool engineer by the Boeing Aircraft Co., Seattle, Wash.

JOHN L. RIZZOLI (University of Illinois '51) is an inspection engineer for the Standard Oil Co. of Indiana, Wood River, Ill.

JUDE L. NAES (St. Louis University) is a B47 jet mechanic in the U. S. Air Force. He is at the Amarillo Air Force Base, Texas.

A. RUSSELL MILLER, JR. (Case Institute of Technology '53) has joined Thompson Products, Inc., Tapco Division, Cleveland.

PAUL RICHARD SCANNELL (Stevens Institute of Technology '53) is now an assistant engineer in Reachon Motors, Inc., Rockaway, N. J.

GILBERT KELLEY, JR. (General Motors Institute '53) is now employed by General Motors, Wilmington, Del., as a tool room follow-up engineer.

JAMES A. WHITACRE (General Motors Institute '53) is now in the U. S. Army.

LAWRENCE D. PORTER (Northrop Aeronautical Institute '53) is a junior engineer in the Douglas Aircraft Co., El Segundo, Calif.

WILLIAM H. KALLEN (Academy of Aeronautics '53) is employed by Wright Aeronautical Corp., Wood-Ridge, N. J.

JOSEPH F. LANG (Detroit Institute of Technology '53) has joined WJR Goodwill Station Inc. Detroit, as a radio engineer.

ROGER C. JAQUA (General Motors Institute '53) is a gear engineer in the Chevrolet-Toledo Division of GMC.

ALFRED MUNN (Stevens Institute of Technology '53) is an engineer with Experimental Towing Tank, Hoboken, N. J.

ALVIN L. BECKER (Northrop Aeronautical Institute '53) is with the Marman Products Co., Los Angeles, as a draftsman.

PATRICK R. MOORE (Lawrence Institute of Technology '53) is now an electrical engineer in the Chrysler Corp., Highland Park, Mich.

JACK CRAIG GRACE (Ohio State University '52) is a research associate, Ohio State University, Columbus.

Continued on Page 96

Obituaries

CHARLES D. HAWLEY

Charles D. Hawley, manager of administration at Ethyl Corp.'s research laboratories in Detroit, died suddenly November 28 at his home in Birmingham, Mich. He was 52.

Hawley joined Ethyl Corp. in 1927 and as assistant director of engineering research was instrumental in organizing and establishing Ethyl's research laboratories in Detroit in '28.

Born in East Tawas, Mich., he received a B.S. degree in mechanical engineering from Oregon State College in 1925. He was an instructor at Harvard Engineering School where he took graduate work until 1927.

Besides holding membership in SAE, he was a member of the Engineering Society of Detroit, American Society of Mechanical Engineers, Society for the Advancement of Management, and Delta Upsilon Fraternity.

WILLIAM RICHARDS

William Richards, 51, author, died suddenly Sept. 23.

Richards entered the engineering field in 1926 as a sales engineer for N. Snellenburg & Co., Phila. At Snellenburg he supervised the installation of laboratory equipment. He later became head of the Mechanical Engineering School, International Correspondence Schools, Scranton, Pa. He was in charge of writing instruction texts for the school, including diesel engine instruction and engineering training.

A native of Ransom, Pa., Richards attended the Drexel Institute of Technology, Philadelphia. He received the B.S. degree in electrical engineering.

He was a member of the ASME, the ASRE, and the Professional Engineers Society, as well as SAE.

ARTHUR H. BLANCHARD

Arthur H. Blanchard, highway traffic and transport engineer, died Sept. 1. He was 76.

Blanchard was author of many papers for technical societies and was editor-in-chief of the 1924 American Highway Transport Handbook. Author of many books on highway engineering, he wrote the section on highway engineering in the American Civil Engineers' Pocketbook.

He was born in Providence, R. I., and attended the Providence English High School. He had a Civil Engineering degree from Brown Univ., and an AM degree from Columbia.

He was a member of SAE, the American Society of Civil Engineers, the Societe des Ingenieurs des Civils de France, and the Engineering Institute of Canada, among many other organizations. At one time he was deputy state highway engineer for the state Board of Public Roads of Rhode Island. He was first instructor, then an assistant professor, and later an associate professor of civil engineering at Brown University. At Columbia he was professor of highway engineering, and at the University of Michigan was professor of highway engineering and highway transport.

HERMAN CHARLES SCHULTZ

Herman Charles Schultz, general manager of the Diamond T Truck Co., died of a heart attack last Christmas Eve, in his office. Schultz was 50.

For many years he had been the vice-president and general manager of the Sterling Motor Corp., which was dissolved last year.

Schultz was born in Greenpoint, Long Island, N. Y., but had lived in Los Angeles for 22 years.

Besides the SAE, he belonged to the Corinthian Masonic Lodge, No. 488, New York City, and to the California Motor Truck Association.

EDWARD DICKSON MALTBY

Edward Dickson Maltby died of a heart attack, November 1, while on a business trip to New York City. He was 60.

Maltby was the president and founder of the Edward D. Maltby Co., Inc., Los Angeles, a firm of engineering and sales representatives for manufacturers. This organization was founded in 1919 and now has branches in Phoenix, San Diego, Honolulu, and Maywood, Calif. Mr. Maltby had been a member of SAE since 1927.

ROLLIN ABELL

Rollin Abell, 73, inventor and mechanical engineer, died Nov. 22. Abell began his career as an apprentice draftsman at the age of 14 years. He later went into business for himself. He had 40 patents in Washington and did business with Henry Ford, Chrysler, the Buick plant, Bendix, and many other companies.

Withrow and Bowditch . . .

. . . win the 1952 Horning Award for autoignition paper.

WINNERS of the Horning Memorial Award for the best "fuels" paper presented before the SAE during 1952 were Lloyd L. Withrow and Frederick W. Bowditch of the GMC Research Laboratories Division.

The award, which consists of a medal and cash award, was presented to the authors at the 1954 SAE Annual Meeting.

They won the award for "the best paper relating to the adaptation of fuels to internal-combustion engines or the adaptation of internal-combustion engines to fuels" presented before a national or section meeting of the Society during the year.

Their paper, "Flame Photographs of Autoignition Induced by Combustion-Chamber Deposits," was presented at the 1952 SAE Annual Meeting. It was printed in full in the SAE Quarterly Transactions, October, 1952, pages 724-752.

Dr. Withrow graduated from Oberlin College and received his master's and doctor's degrees from the University of Wisconsin. He has been with the GM Research Laboratories since 1926, where he has specialized in the study of fuels and engine combustion. He has been head of the Fuels & Lubricants Department since 1952. Jointly with Dr. G. M. Rassweiler, he also received the 1938 Horning Award for a paper entitled, "Motion Pictures of Engine Flames Correlated with Pressure Cards," the first authors to win the award.

Dr. Bowditch graduated from the University of Illinois and obtained his master's and doctor's degrees from Purdue University. During World War II he served in the U. S. Navy. He joined General Motors Research Laboratories Division in 1950, where he is now a senior research engineer in the Fuels & Lubricants Department.

Production Sponsor

A. W. Phelps, chairman of the board, Oliver Corp., is Sponsor of the 1954 SAE National Production Meeting, to be held in Chicago, March 29-31. Phelps was photographed as he mingled with the guests at the pre-dinner reception at the Annual Meeting

SAE National Meetings . . .

Meeting	Date 1954	Hotel
Passenger Car, Body, and Materials	March 2-4	Hotel Statler, Detroit
Production Meeting and Forum	March 29-31	The Drake, Chicago
Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display	April 12-15	Hotel Statler, New York City
Summer	June 6-11	The Ambassador, Atlantic City, N. J.
West Coast	Aug. 16-18	Hotel Statler, Los Angeles
Tractor and Production Forum	Sept. 13-16	Hotel Schroeder, Milwaukee

EMBLEM . . .

. . . contest is bringing out latent artistic talent in membership.

SAE'S Golden Anniversary emblem contest already has drawn more than 500 contestants. And entry applications are still coming in. Members from all over this country and Canada have submitted entry blanks, reports M. A. Thorne, chairman of the SAE Public Relations Committee, which is sponsoring the contest.

The contest seems to have fired the imagination of members right across the board. Vying for the $200 first prize will be SAE'ers ranging from silver certificate members to enrolled students, from chief engineers to junior engineers.

The winning emblem will be the one which best symbolizes the Society's new horizons in terms of its achievements in its first 50 years. It will be used throughout SAE's Golden Anniversary year, 1955, in SAE publications, on programs, stationery, and banners.

The emblem contest first was announced in the November, 1953, SAE Journal. SAE Sections followed up this initial announcement with individual notices to their members. Interest in the contest continues to run high. Each day brings new entries in the mail to SAE headquarters.

The contest closes on April 1, 1954. The SAE Public Relations Committee will judge all design entries shortly thereafter.

P R O G R A M

1954 SAE PASSENGER CAR, BODY, AND MATERIALS MEETING

Hotel Statler, Detroit — March 2-4, 1954

Tuesday, March 2

9:30 a.m. — **Grand Ballroom**

Welcome—W. E. JOMINY, General Chairman of Meeting

Chairman—VINCENT AYRES, Eaton Mfg. Co.
Secretary—D. R. KINKER, Chrysler Corp.

SYMPOSIUM—Cam and Tappet Wear Problems

Wear, Scuffing and Spalling in Passenger Car Engines
H. A. AMBROSE and J. E. TAYLOR, Gulf Research and Development Co.
Customary bench tests of lubricating oils can be misleading in evaluation of anti-wear characteristics. Metallurgy, oil additives, and oil viscosities must be watched.

The Influence of Lubricant and Material Variables on Cam and Tappet Surface Distress
T. W. HAVELY, C. A. PHALEN, and D. G. BUNNELL, Shell Oil Co.
Test observations of three overhead-valve V-8 engines for pitting and scuffing indicate that lubricants exert profound effects. Proper selection both of lubricants and materials appears to be essential.

Lifters and Lubricants
PAUL VERMAIRE, Diesel Equipment Division, and J. B. BIDWELL, Research Laboratories Division, General Motors Corp.
Operating conditions at cam and valve lifter interfaces cause deterioration through wear and fatigue. There are relationships between these types of failure and design, materials, and lubricants.
(Sponsored by Passenger Car Activity)

2:00 p.m. — **Grand Ballroom**

Chairman—W. H. GRAVES, Packard Motor Car Co.
Secretary—J. T. O'REILLY, Ford Motor Co.

PANEL—Painting of Automotive Vehicles

Evaluation of Automotive Synthetic Enamels
R. I. PETERS, Ditzler Color Division, Pittsburgh Plate Glass Co.

Enamels
A. J. LAPOINTE, Ford Motor Co.

Lacquer as a Finish on Automobiles
R. J. WIRSHING, Research Laboratories Division, General Motors Corp.

Automotive Paint—Processes and Equipment
R. E. VAN DEVENTER, Packard Motor Car Co.

Trends in New Finishes
R. B. DAVIS, Marshall Laboratory, E. I. du Pont de Nemours and Co., Inc.
Automotively-speaking, paint has become a word of multiple meanings. This symposium seeks to develop data provocative of more than surface thinking about lacquers, enamels, polymers, and other finishes.
(Sponsored by Engineering Materials Activity)

8:00 p.m. — **Grand Ballroom**

Chairman—H. E. CHESEBROUGH, Chrysler Corp.
Secretary—RICHARD SINKO, Chrysler Corp.

The Science of Glamour
S. L. TERRY, Chrysler Corp.
Color and fabrics have become increasingly important in the successful merchandising of automobiles, but beautiful and harmonious results can be obtained only through the skillful use of scientific tools and procedures as an essential adjunct to the art of the designer and stylist. Scientific and technical factors and history are dealt with plus a few projections.
(Sponsored by Body Activity)

Wednesday, March 3

9:30 a.m. — **Grand Ballroom**

Chairman—M. L. FREY, Allis-Chalmers Manufacturing Co.
Secretary—S. M. FREY, Ford Motor Co.

SYMPOSIUM—Influence of New Forming Methods on Design

Hot and Cold Forging
R. G. FRIEDMAN, The National Machinery Co.

Koldflo Extrusion Permits New Advances in Design
D. I. BROWN, Mullins Manufacturing Corp.

Steel Extrusion and Its Value to the Designer
S. O. EVANS, Babcock and Wilcox Co.

The Influence of Proper Lubrication on the Design of Cold Extruded Components
J. F. LELAND, Parker Rust Proof Co.
New or altered materials, plus new forming processes and machines afford opportunities for greater achievements in body design and shaping. Among possibilities is extruding to finish shape without machining.
(Sponsored by Engineering Materials Activity)

2:00 p.m. — **Grand Ballroom**

Chairman—F. S. SPRING, Hudson Motor Car Co.
Secretary—P. W. TABB, Hudson Motor Car Co.

The Size, Structure, and Shape of European Bodies
LAURENCE POMEROY, The Motor, England
Hands and heads are reaching across the seas to get the low-down on body designs. There's both borrowing and melding of ideas and lines which suggest the shape of bodies to come.
(Sponsored by Body Activity)

8:00 p.m. — **Grand Ballroom**

Chairman—J. B. MACAULEY, JR., Ethyl Corp.
Secretary—H. A. TOULMIN, Chrysler Corp.

A Review of Some Contemporary British Passenger Car Engines
C. L. GOODACRE, Clifford Motor Components, Ltd., England
British engine designers, rid of tax restrictions only to bump into high-cost low-octane fuels, have been forced to exercise ingenuity. It has produced powerplants capable in performance and interesting in engineering detail.
(Sponsored by Passenger Car Activity)

Thursday, March 4

9:30 a.m. — **Grand Ballroom**

Chairman—R. D. EVANS, Goodyear Tire and Rubber Co.
Secretary—M. G. ANDERSON, Goodyear Tire and Rubber Co.

Car Stability and Transient Tire Forces
S. A. LIPPMANN, United States Rubber Co.
The way of a driver with a car can be affected by its responses which, in turn, can be influenced by tire properties. Interesting particularly are the side forces which affect degree of control.
(Sponsored by Passenger Car Activity)

2:00 p.m. — **Grand Ballroom**

Chairman—ROBERT SCHILLING, General Motors Corp.
Secretary—M. D. T. KENNEDY, Thompson Products, Inc.

SYMPOSIUM—Car Shake

The Effect of the Car's Suspension on Car Shake
R. R. PETERSON, Chrysler Corp.

Structural Properties of Frame and Body Needed to Suppress Car Shake
M. J. GARLICK, Pontiac Motor Division, General Motors Corp.

Flexible Engine Mountings Can Cause Car Shake
L. H. FRAILING, Packard Motor Car Co.

Shake Control on Convertibles
M. KAMINS and W. B. LOVE, Studebaker Corp.

Road Instrumentation to Measure Car Shake
R. J. SAXON, Ford Motor Co.

Laboratory Simulation of Car Shake
MAX RUEGG, General Motors Corp.
Car shake is a tangible result of multiple causes, among them roads, suspension, car stiffness, and engine mountings. Instrumentation, road tests, and laboratory studies point various ways to solve the problem.
(Sponsored by Passenger Car Activity)

Thursday, March 4

6:30 p.m. — **Grand Ballroom**

Dinner

K. E. COPPOCK
Chairman, SAE Detroit Section

ROBERT L. BIGGERS
Toastmaster
President, Fargo Division, Chrysler Corp.

WILLIAM LITTLEWOOD
SAE President

"America's Answer to the Threat of Aggression"

Gen. Curtis E. Le May, USAF
Commander, Strategic Air Command

SAE Section Meetings

Atlanta—Feb. 15

Ship A Hoy Restaurant. Dinner 7:00 p.m., meeting 8:15 p.m. Nuclear Reactors—John H. Tolan, radiological physicist, Georgia Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Ga.

Buffalo—Feb. 11 and 17

Feb. 11—Hotel Sheraton. Dinner 6:30 p.m., meeting 8:00 p.m. Light Car Symposium—Representatives of Nash, Willys and Hudson Motor Car Companies.

Feb. 17—Rochester Division. Lorenzo's. Industry and Education—Are We on Common Ground? Symposium with representatives of Industry, Education and Student Body.

Canadian—Feb. 17

Roof Garden, Royal York Hotel, Toronto. Dinner 6:30 p.m., meeting 8:00 p.m. Students Night. Professor E. A. Allcot, engineering faculty, University of Toronto.

Chicago—Feb. 9

Knickerbocker Hotel, Chicago. Dinner 6:45 p.m., meeting 8:00 p.m. Diesel Power Increase-Turbocharge—L. L. Bower, chief engineer, Waukesha Motor Co. Social half-hour sponsored by Chicago Rawhide Mfg. Co., Schwitzer-Cummins Co. and United Specialties Co.

Cleveland—Feb. 8

Allerton Hotel. Dinner 6:30 p.m., meeting 7:30 p.m. Space Flight—D. C. Romick, aero physicist, Guided Missiles Department, Goodyear Aircraft Corp., Akron, Ohio.

Colorado—Feb. 25

Petroleum Club. Dinner 6:30 p.m., meeting 8:00 p.m. Oil Filters—Herb Otto, chief engineer, Purolator Products.

Detroit—Feb. 15

Jet Motor Assembly and Test Plant. Packard Motor Car Co., Utica, Mich. Dinner Meeting 6:30 p.m. The Hot Rod and its Meaning—Richard Stickley, regional advisor, National Hot Rod Association. Toastmaster: W. H. Graves, vice-president, Packard Motor Car Company. 5:00 p.m. Tour of Jet Motor Assembly and Test Plant and a display of Hot Rods.

Indiana—Feb. 11

Marott Hotel, Indianapolis, Indiana. Dinner 7:00 p.m., meeting 8:00 p.m. Recent Developments in Continental Gas Turbines—R. M. Russell, Continental Aviation and Engineering Co., Detroit, Michigan.

Mohawk-Hudson—Feb. 9

American Locomotive Co., Schenectady, N. Y. Dinner 6:45 p.m., meeting 8:00 p.m. Diesel Locomotive Maintenance—Stanley Lodge, Alco Educational Program American Locomotive Co., Schenectady, N. Y.

Northern Calif.—Feb. 24

Engineers Club, San Francisco, Calif. Dinner 6:30 p.m., meeting 8:00 p.m. Fuel Economy for the Automotive Engine—Robert J. Greenshields, director of research, Wood River Laboratories, Shell Oil Co., Wood River, Illinois.

Southern Calif.—Feb. 11 and March 18

Feb. 11—Rodger Young Auditorium. Dinner 6:30 p.m., meeting 8:00 p.m. The Airport Problem—Fred M. Glass, director of aviation, Port of New York Authority.

Mar. 18—Rodger Young Auditorium. Dinner 6:30 p.m., meeting 8:00 p.m. Equipment Maintenance in Small Fleets—LaVerne Morgan, manager of the Edward R. Bacon Co., Oakland, Calif.

Southern New England—Mar. 3

Yale University, New Haven, Conn. Dinner 6:30 p.m., meeting 8:00 p.m. The 1954 Automobile from the Consumer's View Point—Lawrence Crooks, auto consultant, Consumer's Union.

Spokane-Intermountain—Feb. 16

Desert Caravan Inn. Dinner 6:30 p.m., meeting 7:30 p.m. Topic not announced—F. B. Nyland, service manager, Ford Motor Co., Seattle, Wash.

Texas Gulf Coast—Feb. 12

Ye Olde College Inn, Houston. Dinner 6:00 p.m., meeting 7:30 p.m. High Speed Diesel Operation—Geo. Stevens, manager, Mid-Continent Area, Cummins Engine Co., Ft. Worth, Texas.

Twin City—Feb. 10

Curtis Hotel. Dinner 6:30 p.m., meeting 8:00 p.m. Automotive Interior Design—Ethyl Corp. Ladies Night.

Western Michigan—Feb. 16

Bill Sterns Steak House, Muskegon. Cocktail Hour 6:30 p.m. Courtesy Perfect Circle Co. Dinner 7:00 p.m., meeting 8:00 p.m. Transportation—E. F. Lewis, General Motors Corp.

Williamsport—Mar. 1

Moose Club. Dinner 6:45 p.m., meeting 7:45 p.m. Personal Aircraft Development—W. T. Piper, president, Piper Aircraft Corp., Lock Haven, Pa.

Metropolitan—Feb. 9 and 17 and Mar. 11

Feb. 9—Chrysler Theater, Chrysler Bldg., 42nd St. and Lexington Avenue, New York, N. Y. Meeting to be held at 2:00 p.m. Symposium on Sports Cars of Tomorrow. Evening Session. Park Avenue Brass Rail, 100 Park Avenue, New York, N. Y. Cocktail Hour 5:30 p.m., dinner 6:30 p.m., meeting 7:45 p.m. Toastmaster—William L. Welsh, Society of Motor Manufacturers and Traders—P. H. Pretz, moderator, Ford Motor Co.—Maurice Olley, Chevrolet Division, GMC—Lawrence Pomeroy, The Motor Magazine—E. J. Premo, Chevrolet Division, GMC.

Feb. 17—The Engineering Societies Building, 29 West 39th St., Fifth Floor. Meeting 7:45 p.m. Automatic Transmissions in Heavy Duty Trucks—Merrill C. Horine, consulting engineer, Mack Truck Corp.

Mar. 11—Fifth Avenue Brass Rail, 521 Fifth Ave., N. Y. Cocktail Hour 5:30 p.m., dinner 6:30 p.m., meeting 7:45 p.m. The Engineer and High Speed Air Transport—1954 SAE President William Littlewood, vice-president, engineering, American Airlines, Inc.

Test Laboratories Acquire the New Look

AUTOMOTIVE laboratories of new or revamped design are featuring layouts and equipment to permit better control and maintenance, easier cleaning, and greater comfort for operators. Designs to achieve these advantages differ greatly between laboratories and there is marked difference in equipment employed.

At the new engine test laboratory for studying fuels and lubricants recently built by Standard Oil Development Co., the nine multicylinder test cells are grouped in units of three, each unit having its own control room, to achieve economy of floor space. The operator has maximum view of the engine cell, unobstructed control panel, conveniently placed instruments, and minimum travel for adequate coverage of engines.

Shell Oil Co., on the other hand, in expanding its facilities has built ten test cells, five on each side of a corridor which is slightly offset to permit five cells on the one side to be larger than those opposite. Controls and instruments are located in the operating corridor, which has been made relatively quiet. This arrangement permits one shift operator to handle all ten cells.

Portable cranes were selected for moving equipment in preference to an overhead rail system, thus permitting light building construction. Congestion is avoided by using concrete ramps which encircle the building (Southern California climate permits) so that all traffic is handled outside the building rather than through the corridor. Engines are mounted on simple steel box frames that fit any engine, and if multicylinder, are bolted to the concrete floor. When stand is removed there are no projections above floor.

Still another layout is featured by Sinclair Research Laboratories, Inc. Here the main aim was operational feasibility for both day and night shifts, which made central common control rooms desirable for those cells where long endurance-type tests were conducted. For safety and ease of service double access is provided to each test cell. Major heat release test cells were grouped for easiest ventilation and sound proofing and for best distribution of utilities and exhaust system layout. Close to the center of the building are four large multi-engine rooms adjacent to a control room. Other features are an air-conditioned measurement room and an inspection room for parts examination.

For maximum flexibility, Union Oil Co. of California has located all engines in one large room rather than in individual cells. The 12 identical bedplates can support a multicylinder diesel as well as a group of single-cylinder gasoline engines. All can be handled by a normal staff of two operators. Bedplates are set flush and this, coupled with the running of all exhaust, water, and air lines and conduits beneath the floor, makes for easy cleaning. It also frees the overhead, permitting a travelling crane to reach any part of the engine room.

New facilities of the Standard Oil Co. (Indiana) have test units placed in parallel rows. Units are spaced 12 ft on centers to insure adequate working area. Ceiling height is 22 ft. Acoustical insulation holds noise level within acceptable limits. Each engine and dynamometer unit is mounted on a cast-iron bedplate set level with the floor and secured to a thick concrete slab isolated from the floor which rests on a subgrade of sand for vibration dissipation. Ventilated trenches carry piping, electrical power, and instrument lines.

Each test stand has its individual control panel. All pressure and vacuum lines, thermocouple wires, electrical conduits, and control cables are carried below floor to either engine or dynamometer.

After study of many installations, the California Research Corp. has constructed a chassis-dynamometer laboratory capable of handling the largest truck tractor unit as well as standard passenger cars. It comprises a test cell 33 ft long and 22 ft wide; fan, control, and locker rooms; and a refrigeration equipment room. The dynamometer system, located in the basement under the test cell, can absorb 300 hp at speeds up to 100 mph. An automatically controlled 450,000-Btu heating system permits maintenance of temperatures up to 120 F, while the refrigeration system can provide controlled temperatures down to -40 F. Electronic control of dynamometer load and equivalent system inertia is used.

This article is based on six papers:

A Modern Petroleum Test Engine Laboratory
By O. G. Lewis, T. W. Osbahr Jr., and S. C. Sperling
Standard Oil Development Co.

A New Look to an Old Laboratory
By F. H. Caudel
Shell Oil Co.

Some Design Features of the Sinclair Engine Laboratory
By M. L. Hamilton
Sinclair Research Laboratories, Inc.

An Automotive Research Laboratory in Southern California
By N. G. Allison, W. L. Kent, and C. C. Moore
Union Oil Co. of California

New Tools for Research on Fuels and Lubricants
By J. B. Duckworth, W. W. Frank, and J. H. Schruben
Standard Oil Co. (Indiana)

An All-Weather Chassis Dynamometer
By B. W. Moore, J. H. Macpherson, and V. C. Davis
California Research Corp.

These papers were presented at SAE Summer Meeting, Atlantic City, N. J., June 9, 1953. They are available in full separately in multilithographed form from SAE Special Publications Department at 35¢ each to members; 60¢ each to nonmembers.

Designing Aircraft To Meet Pilot's Needs

Based on paper by

B. G. PETERSON

North American Aviation, Inc.

A PILOT of a military plane thinks of maneuverability in terms of his ability to control his own plane and to place it in the most advantageous tactical position with respect to another. In this respect, high performance is a definite asset to maneuverability.

Basic performance is considered conventionally in terms of: level flight maximum speeds, rates of climb, climb speed, ceiling, and the like. These items reflect the end result of the thrust-drag characteristics of an airplane as well as the excess thrust available. Performance as it affects maneuverability must meet basic mission requirements and possess certain thrust-drag relationships. These characteristics are shown in Fig. 1.

In level flight the total drag is of a certain level depending on the flight Mach number. The thrust available curve, then, intersects the drag curve to define V_{max}. At the lower speeds, the excess of thrust available over drag can be used for climb or acceleration. From the maneuverability standpoint the excess thrust can be used to maintain speed while making a constant altitude turn. As shown

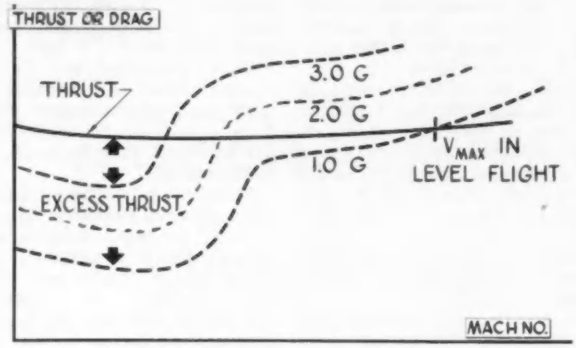


Fig. 1—Basic thrust-drag characteristics which must be taken into consideration when designing for high performance to gain maneuverability

in Fig. 1, the overall drag increases with load factor. This is simply the familiar drag due to lift. Obviously the V_{max} then must decrease. Eventually, at relatively high load factors the excess thrust available will be insufficient to counteract the increased drag due to lift and the airplane will slow up continually in the turn. This can be compensated for by a shallow dive to keep the speed up. In combat between airplanes of almost equal capabilities on a direct thrust and speed basis, the one having the least drag due to lift will have an advantage. It will be apparent as a tighter turning ability at a constant altitude, or as a lesser amount of altitude lost in a diving turn of comparable radius to that of the opposing airplane.

Drag due to lift is, then, an extremely important factor in providing good maneuverability, and is basically a function of the wing selection. (Paper "Design Considerations for Maneuverability of High Speed Airplanes" was presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 1, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members; 60¢ to nonmembers.)

Tractor Testing Still Faces Problems

Based on paper by

L. F. LARSEN and C. W. SMITH

University of Nebraska

FROM the tractor buyer's standpoint, the Nebraska Tractor Testing Laboratory's effort to encourage each manufacturer to have his product show the best possible performance is becoming unreasonable. Yet there are those idealists who continue to seek to have the power output and efficiency of a tractor extended by use of mathematical procedures on which there is little, if any, general agreement.

Some want us to base fuel consumption on corrected horsepower and show corrected horsepower for all maximum tests. This seems unreasonable to the Test Board which must answer to farmers and the State Railway Commission as well as industry. Many feel we show too many figures now and should simplify our reports.

Selection of hitch height, amount of ballast added, tire size and tread are chassis variables now controlled within limits by the manufacturers' representatives. On some tractors the drawbar is set at a height impractical for general use. On others, added ballast in the form of cast-iron wheel weights makes the tractors abnormal in appearance and greatly limited in use. The abnormally large tires selected by some do not have a practical clearance with frame or fenders.

Manufacturers' representatives ask us why we do not use a concrete or other hard surfaced test course in place of the especially prepared earth course. A hard surface might save some delay in testing, but the cost is prohibitive without raising the testing fee. Foreign engineers have suggested a disked test course, believing it to be more practical. They report that test results would be more uniform. Thus, the variety of ideas expressed about surfaces for drawbar test courses emphasizes the need for some practical standards to be developed or accepted by interested professional groups.

The recent emphasis some manufacturers have placed on torque characteristics brought a strong demand for a torque test. Some suggested this be taken during drawbar tests. A more practical plan seemed to be the recording of dynamometer torque during the belt tests. This choice is not universally popular with tractor engineers, though it would yield practical data for the use of farmers interested in torque characteristics.

Foreign visitors report the need for developing a practical international testing code, planned to emphasize information for the buyer rather than for the engine or tractor designer. That challenge exists now and deserves prompt and serious consideration by the SAE and the American Society of Agricultural Engineers. (Paper, "Tractor Testing at the University of Nebraska" was presented at SAE National Tractor Meeting, Milwaukee, Sept. 16, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members; 60¢ to nonmembers.)

Based on Discussion

Peter Burns

The Oliver Corp.

We feel that every possible effort should be made to simplify the report and that everyone should be urged to consider the significance of each individual section of the test, rather than to place undue emphasis on any one portion. We also agree that a practical testing code is needed which emphasizes information for the buyer.

We suggest the discontinuance of all drawbar tests. In their place, torque at the axles would be measured with curves to translate this axle torque into field drawbar performance.

We see no reason to argue over mathematical correction formulae. Any formula could be used which has been proven reasonably accurate. The important thing is to apply it equally to all tractors.

Merlin Hansen

John Deere Waterloo Tractor Works

The abnormally large tires, added ballast, and impractical drawbar height problem might be solved by making the test tractor photograph record the equipment and be made a part of the report. It might be possible to insist that the drawbar height fall within the range specified in the

Turn to Page 102

Contemplate Fine Series Of Dryseal Pipe Threads

INCREASING evidence of the need for a fine series of dryseal pipe threads has lead the SAE Screw Threads Committee to assign to its Dryseal Pipe Threads Subcommittee the task of developing this thread series.

It has been found that, although the standard dryseal pipe threads work in most cases, occasionally there is an application where a finer thread is needed to give a satisfactory seal.

According to R. F. Holmes, AC Spark-Plug Division, GMC, and chairman of the subcommittee, the following diameter-pitch combinations are now under consideration: ¼-27, ⅜-27, ½-18, ¾-18, 1-14, 1¼-14, 1½-14 and 2-14.

So as to differentiate the fine series from the present threads, Chairman Holmes noted that a "C" will probably be added after the diameter-pitch combination for the present (coarse) series and an "F" for the proposed fine series. The word "SPECIAL" would be used to designate specially formulated threads. The following examples show how the proposed designations would be used:

¼-18C—NPTF (for the existing standard).

¼-27F—PTF (for the fine series).

½-27 SPECIAL—PTF (for specially formulated threads).

As an additional point, Chairman Holmes also reported that consideration was being given to including in the introduction to the SAE Standard for Dryseal Pipe Threads information on the method of calculating any diameter-pitch combinations for dryseal pipe threads. Such information would be used only to formulate special threads, when there is no suitable thread in the Standard.

1954 SAE Technical Board

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S-2 Studying Problems of Helicopter Turbine Engine

PLANS are afoot for developing a standard to cover powerplant installation details and power take-off design for turbine-powered helicopters. The work will be handled by a subcommittee of the SAE Helicopter Committee S-2. So that the final result will represent the views of the entire industry, engineers from both the helicopter manufacturers and the powerplant builders are serving on the subcommittee.

The need for this standard was emphasized at a recent committee S-2 meeting. It was stated, for instance, that there isn't even agreement on a recommended turbine rpm for helicopter installations.

To find out just what present-day practices and opinions are on this and many other controversial points, a questionnaire covering all the more debatable matters has been distributed throughout the industry. With the replies to this questionnaire, the subcommittee hopes to obtain a consolidated opinion, from which the standard can be developed.

Controversial points covered in the questionnaire include:

1. What is the optimum envelope of the turbine bulk, with particular reference to the following: circumscribed circle should be favored over length; or, if accessories must project beyond basic engine circumscribed circle, should they compromise height, or width?
2. Since new turbines will have useful life over a great variety of future configurations, should the drive be located on the inlet or exhaust end of the turbine?
3. Regardless of drive and location, and taking careful consideration of high-speed gearing, bearing, and shafting requirements, would you prefer that the turbine be supplied with a reduction gear or with direct drive?
4. Assuming a majority prefer the turbine manufacturer to be responsible for some reduction, what output speed would you prefer?
5. Assuming a majority prefer the turbine manufacturer to be responsible for some reduction, would you prefer a planetary or offset spur reduction?
6. Assuming the majority prefer an offset spur reduction, should the offset be to the top, to the bottom, or lateral?
7. Do you anticipate the need of bleed air from the compressor, even if the power represented by the bleed air could be taken more efficiently (from a weight standpoint) from the shaft as shaft power?
8. Do you prefer a bifurcated or forked inlet air duct or a circumferential axial-flow inlet?
9. Assuming the drive shaft to be located at the exhaust end, which type of exhaust manifold do you prefer?
10. Do you anticipate the need for an accessory power-take-off pad on the engine, and if so, how much power at what rpm?
11. Where would you prefer the engine mount pads to be located relative to the water line plane through the engine center: above, below, other?
12. Do you require a positive lock on the output shaft and would it be justifiable from a weight point of view if it could not hold against full rated torque?
13. Would you desire a torque meter on the turbine?

Miller A. Wachs of Sikorsky has been reelected chairman of SAE Helicopter Committee S-2 for the coming year

27 Receive SAE Technical Board

THE 27 men shown on these pages are the first recipients of SAE Technical Board Certificates of Appreciation. The certificates honor them for their outstanding service on SAE technical committees. 1953 SAE President Robert Cass presented the awards at the Society's Annual Business Meeting session, Tuesday evening, January 12.

Some of the men receiving the newly established award were honored for the contributions they made in the past, although they are no longer active. They have been leaders in technical committee work, contributing research effort and developing standards and tests. They were proposed for the awards by a committee consisting of R. P. Lewis, C. E. Mines, and W. M. Walworth. The committee consulted committee chairmen and others before making the recommendations on which the Board acted.

The Board plans to issue certificates of appreciation annually in the future. Nominations for next year's awards are already being received from technical committees. Rules for the award stipulate that not more than 30 are to be bestowed in any one year. Those cited and the committees on which they served were:

Arthur Nutt
Aeronautics Committee

Bishop Clements
Aeronautical Material Specifications Division of the Aeronautics Committee

Wright A. Parkins
Aeronautics Committee

William Littlewood
Aeronautics Committee

John G. Perrin
Aeronautical Drafting Manual Committee of the Aeronautics Committee

Erle Martin
Aeronautics Committee

Val Cronstedt
Aeronautics Committee

Merrill C. Horine
Truck and Bus Technical Committee and Commercial Vehicle Nomenclature Committee

James W. Bridwell
Construction and Industrial Machinery Technical Committee

P. J. Kent
Electrical Equipment Committee

A. L. Clayden
Fuels and Lubricants Technical Committee

H. C. Mougey
Fuels and Lubricants Technical Committee

G. A. Round
Fuels and Lubricants Technical Committee

T. C. Smith
Highways Research Committee and Lubricants Research Committee

E. W. Upham
Fuels and Lubricants Technical Committee

F. P. Gilligan
Iron and Steel Technical Committee

John O. Almen
Iron and Steel Technical Committee

W. P. Eddy, Jr.
Iron and Steel Technical Committee


Nutt


Clements


Parkins


Littlewood


Perrin


Martin


Cronstedt


Horine


Bridwell


Kent

Certificates of Appreciation

C. H. Stanard
Parts and Fittings Committee

G. L. McCain
Parts and Fittings Committee

W. L. Barth
Screw Threads Committee, Tube, Pipe, Hose and Lubrication Fittings Committee and as SAE Representative on ASA Sectional Committees B5, B18 and B46

C. G. Davey
Tube, Pipe, Hose and Lubrication Fittings Committee

W. F. Little
Lighting Committee

B. B. Bachman
Brake Committee and Motor Truck Rating Committee

John H. Hunt
General Standards Committee

F. K. Glynn
Motor Truck Rating Committee and Commercial Vehicle Nomenclature Committee

Tore Franzen
Spring Committee


Clayden


Mougey


Round


Smith


Upham


Gilligan


Almen


Eddy


Stanard


McCain


Barth


Davey


Little


Bachman


Hunt


Glynn


Franzen

Burning Velocities of Twelve Fuels Available

RELATIVE combustion properties for 12 fuels can be found in a CRC report entitled, "Relative Burning Velocities, Ignition Energies, and Quenching Distances for 12 Fuels."

The particular 12 fuels are available in pure form, similar in vapor pressure, and represent various chemical structures. They are: n-heptane, isooctane (2,2,4-trimethyl pentane), benzene, toluene, cyclohexane, triptane (2,2,3-trimethyl butane), diisobutylene, 1,3-pentadiene, propyne (methyl acetylene), diethyl ether, carbon disulfid, and propargyl alcohol (2-propyn-1-ol).

The fundamental combustion properties given in the report are:

1. Burning velocity (laminar flame speed).
2. Minimum spark ignition energy.
3. Quenching distance of prevaporized mixtures of fuel and dry air.

The members of the CRC panel that compiled the report are: R. Friedman (leader), Westinghouse Research Laboratories; R. E. Albright, Socony-Vacuum Laboratories; and H. F. Calcote, Experiment, Inc.

CRC 271 contains 12 pages including 4 tables, 3 graphs, and an appendix. It is available from SAE Special Publications Department at 50¢ to members, $1 to nonmembers.

Lubes Affect Plug Fouling in Outboards

SPARK-PLUG fouling of outboard motors is significantly affected by the lubricating oil used, according to a CRC report, "Outboard Motors and Their Lubrication."

This study, which was made at the request of the Outboard Motor Manufacturers' Association, also shows that there are differences in the magnitude of the effect with various makes of motors.

First part of the project consisted in developing a research technique designed to differentiate between lubricating oils with respect to spark-plug failures. The description of this technique (CRC Designation L-32-653, "Research Technique for Comparing the Effects of Lubricating Oil Type on Spark-Plug Fouling Tendencies in Outboard Motors of Different Design") is included in the report.

The next step consisted in evaluating the ability of the technique to differentiate between two oils that two outboard motor manufacturers had indicated were markedly different in their tendencies to cause spark-plug failures. The two oils used were REO-61-49 and REO-62-49.

The general conclusions reached as a result of this test program are:

1. The data accumulated indicate that the technique (CRC L-32-653) is, in general, able to differentiate between oils with regard to spark-plug failure effects.
2. In general, in all motor makes, one oil was equal to or more severe than the other oil with respect to aggravating spark-plug failure tendencies, and no motor make showed a reversal of the general trend.
3. With respect to spark-plug failure tendencies, the difference between motors of different makes, run on either of the two test oils, was greater than the average difference (all motors considered) between the two oils.
4. Repeatability of spark-plug failures in any one laboratory was satisfactory.
5. Reproducibility of spark-plug failures in tests made on the same make motor but run in different laboratories was not entirely satisfactory.
6. Multicylinder motors generally

Turn to Page 109

COCKPIT Committee Gets Award

Jerome Lederer (left) congratulates M. G. Beard, who, on behalf of S-7, has just received a plaque representing one of the air safety achievement awards presented annually by the Flight Safety Foundation. A facsimile of the plaque has also been given to each member of S-7

S-7 Gets Safety Award

SAE Cockpit Standardization Committee S-7 recently received one of the awards for air safety achievement presented each year by the Flight Safety Foundation.

Jerome Lederer, managing director of the Foundation gave the award to M. G. Beard of American Airlines and chairman of S-7 since its inception in 1950.

The citation states that S-7 was chosen to get the award for setting standards for cockpit layout, location and actuation of cockpit controls, cockpit visibility, and lighting.

The presentation was made on Dec. 14, 1953 during the Annual Award dinner of the Foundation, held at San Bernardino, Calif.

The Flight Safety Foundation Awards for "achievement in safer utilization of aircraft" are presented annually by the Foundation on behalf of Aviation Week magazine. Recipients are selected after consultation with air safety specialists and with the approval of the Executive Committee of the Foundation.

from the Sections

Among the outgrowths of awarding membership certificates are the sessions honoring long-time members. The Northwest Section held a panel meeting of its older members who reminisced and told stories about the Section's development. The New England Section has begun a program that includes the honoring of two past-chairmen at each meeting.

Cleveland

Field Editor
W. B. Fiske
Dec. 14

AN AIR CONDITIONING unit for cars of the future will be easily installed and removed like a radio. That is the forecast of F. W. Edwards of the Eaton Mfg. Co.

Edwards pointed out problems that were faced in household refrigeration and the steps taken to eliminate them. He said that both the common kitchen refrigerator and the single unit room cooler have made vast strides, and he sees a similar **period of progress** for the auto air conditioning unit.

This unit, he said, should be small, taking up as little space as possible in the luggage and tire compartments, and should be light in weight. He thinks it is desirable to have the weight over the rear wheels as much as possible. He said that the unit should be quiet, low in cost, and must have many times the capacity of the home refrigerator in a fraction of the space.

John Moran told members that the idea of automobile air conditioning is not new. But, as a production item the **field is new.** Moran is with Chrysler Corp. He discussed the history of cooling cars including the evaporative cooler and the mechanical vapor compression cycle.

H. J. Joyce of Ford said that from a service standpoint, there is the need for special tools and training. He also mentioned that efforts have been made to eliminate auto air conditioning from city codes on general air conditioning.

Detroit

Assistant Field Editor
D. T. Roberts
Dec. 2

JUNIOR MEMBERS toured the GMC Truck and Coach Division at Pontiac, Mich. They spent an enjoyable afternoon observing fabrication and assembly operations.

Highlights of the tour included the assembly of the airplane-type **frameless coach** and the use of kirksite dies for forming many aluminum body parts. One-hundred eighty-five juniors were on hand for the tour.

Assistant Field Editor
G. J. Gaudaen
Dec. 7

"**WILL AMERICANS GIVE UP** their family cars for European styling?" This question was answered by George Romney, the executive vice-president of Nash-Kelvinator Corp.

Romney said that the **future American** car will include both the functionalism in current Italian styles and the **spacious comfort** and convenience desired by Americans. He believes that of the many European designs, only the Italian will have significant influence. He thinks this is so because the

From Section Cameras

Indiana (Nov. 19)

FEELING "AT HOME" in Indiana is Robert Cass, '53 president (center). To his left is Section Chairman A. M. Brenneke. To his right is Courtney Johnson, assistant to the president, Studebaker Corp.

Southern New England (Dec. 3)

HAVING THEIR PICTURE TAKEN are: (l to r) C. H. Nystrom, viçe-chairman; Bruno Loeffler, speaker; Martin Berlyn, technical chairman; L. Morgan Porter, chairman; Hans Hogeman, past chairman.

Northwest (Dec. 4)

SMILING PANEL members are front row: (l to r) Ralph Dennison, John Holmstrom, W. W. Churchill, and Valentine Gephart, (panel chairman). Second row: (l to r) Sherman Bushnell, Wayland Scarff, Ted Howe, and Section Chairman Bob Norrie.

Italian school expresses beauty while retaining the **simplicity** of line and form Americans appreciate. He said, too, that many American companies have either incorporated aspects of Italian styling already, or have sent personnel to consult with Italian designers.

Carl Sundberg, however, sees future American designs influenced by **jet aircraft.** He said that elements of European design in some American cars are only sales features and are not indicative of a trend. He thinks American vehicles have and will continue to influence European design. Styling knows **no international boundaries,** Sundberg said, but is an expression of the environment in which it develops.

Carl Reynolds believes American vehicle design is a reflection of the heterogeneous American heritage and he thinks we need not be self-conscious about this. Reynolds is an industrial designer of Carl Reynolds, Inc.

Mohawk-Hudson

Field Editor
L. F. Smith
Dec. 8

DEVELOPMENT of the basic units involved in brake control systems and the latest design of **air-cooled compressors** were discussed by J. V. Ralston. Ralston is manager of sales engineering for Bendix-Westinghouse at Elyria, Ohio.

He also talked about new devices on trucks and buses which utilize the air brake supply to perform other functions. These include air **hydraulic actuators,** air springs, and air cranking motors, among other things.

Ralston's talk was prefaced by a film that showed the operation and servicing of an air brake system for trucks and buses.

Milwaukee

Field Editor
D. R. Neeld
Dec. 4

THE GAS TURBINE is not to be discounted as a future possibility in vehicle powerplants, according to C. G. A. Rosen. Rosen is consulting engineer for Caterpillar Tractor Co. He has been chairman and member of many of the SAE technical committees.

He said that in some railroad operations the gas turbine has already proven to be a significant contender to diesel **engine economies,** when the overall factors of performance, labor attendance, maintenance cost, and flexibility are given adequate attention. Furthermore, more reasonable economy can be attained on low cost fuels than on fuels at present broadly used in vehicle diesel engines, particularly the premium types of fuels.

Rosen also brought out the fact that in our American economy it is difficult to evaluate the significance of specific fuel consumption. Great emphasis is placed on this factor in Europe. The relative evaluation of the items entering into vehicle operation show that in **European practice** fuel cost is second to labor, the highest cost. The placing of such significant values on fuel cost has naturally fostered development of the direct injection combustion system. Some of these designs have been responsible for achieving fuel consumptions as low as 0.36 lbs per bhp-hr at the minimum point of the consumption curve.

Correction: A. S. Jameson, supervisor of Metallurgical Research Laboratories, International Harvester Co., Chicago, was speaker at Milwaukee Section's Nov. 6 meeting. Jameson's name was inadvertently omitted in the January Journal.

Southern California

Field Editor
William E. Achor
Dec. 17

THE PRIMARY SOURCE of preignition in today's passenger car engine is the heavy flake deposits in the combustion chamber. This is what W. E. Morris told the Section. Morris is supervisor of the knock and road test group, E. I. du Pont de Nemours & Co. He said further that preignition can occur without audible warning knock or wild ping noise.

"Knock" was interpreted by Morris as the spontaneous combustion of gases confined and compressed by the normal flame front propagation. He said that knock is directly controlled by **fuel quality** and could be eliminated with higher octane fuel.

He said wild ping too is caused by preiginition which is usually the result of flaky engine deposits. These deposits act as **glow plugs** to ignite the fuel before the normal spark occurs. Though wild ping is not directly related to fuel octane ratings, it is best controlled by using cleaner fuels and lubricating oils to minimize deposits.

A "rumble" phenomenon which occurs in high compression ratio engines during high speed full throttle acceleration was demonstrated by the playback of a tape recording. Morris associated the rumble to the deposits first created by light duty operation.

In a prepared discussion, C. C. Moore of the Union Oil Co. interpreted the speaker's paper as calling for one thing—higher **octane requirements.** Moore indicated that the nature of the deposits affects their tendency to glow and cause preignition. He said that the constituents and purity of the fuel are important. The same is true of the oils. He also mentioned the insulating characteristics of these deposits which confined the heat, causing higher temperatures and preignition. The tendency of the deposits to keep burning, he said, is influenced by the additives in the gasoline and oil.

Chairman Jack Findeisen presented 25-year certificates to: D. J. Deschamps, F. R. Elliott, C. E. Emmons, J. M. Heiman, W. E. Mason, W. E. Powelson, H. F. Schwedes, and C. Sklarek. Thirty-five year awards were given to: W. A. Baker, S. E. Campbell, R. D. Easton, E. K. Hill, C. A. Sieber, O. W. Sjogren, and C. E. Stryker.

At the conclusion of the meeting, Findeisen announced his resignation because of transfer from

From Section Cameras

Buffalo Section (Dec. 10)

PRESENTING AWARDS is Elliot Chapman, section chairman. Old timers receiving membership certificates are: (left) Past-chairman O. A. Hansen, Linde Air Products, and (extreme right) J. R. Holmes, Harrison Radiator Division of GMC.

Twin City (Dec. 9)

CERTIFICATES for long-term SAE membership were given to: Ralph Upson (second from left), professor of aero engineering, University of Minnesota (35 years); Adolph Ronning (second from right) research engineer (25 years); and Dewey Hult, chief engineer, Auto Engine Works, Inc. (25 years). Newman A. Hall, chairman of the SAE Section (third from right) presented the certificates. At the extreme left is Professor B. J. Lazan of the University of Minnesota who was speaker, and at the extreme right is David Tellet, ASME Section chairman.

Section territory. Taking over Findeisen's post as Section chairman is Homer Wood, vice-chairman of the Section. In recognition of Findeisen's leadership as chairman, Marvin Russell presented him with a gavel on behalf of the Governing Board.

The Section also has been unfortunate in losing other good workers because of transfers and changes in position. Duff Dean has resigned as chairman of the Membership Committee, Jim Gartland as publicity chairman and Jim Fluent is unable to continue as seminar chairman.

Marvin Russell is doubling as Section vice-chairman and reception chairman. Jud Pickup is retaining his job as chairman of the Passenger Car Activity, while taking over as head of publicity. Robert Strasser is replacing Dean as membership chairman. No new appointment to the seminar chairmanship has been announced.

Central Illinois

Field Editor
W. J. Lux
Dec. 14

IN ARCTIC OPERATIONS machines are often left running continuously to **avoid cold starts.** But N. K. Lammers advised automobile owners not operating under extreme conditions to keep engines in good shape, batteries charged, and to use winter oils to make sure cars will start on cold mornings. Lammers was presenting his paper, "Starting Cold Diesels." He is a research engineer with the Caterpillar Tractor Co. in Peoria, Ill.

He said recent developments of new cold-weather lubricants and **improved starting aids** have done much to alleviate this problem.

H. R. Moos, also a research engineer with Caterpillar, presented his paper, "Automotive Application of Exhaust Ejectors." He said that theoretical predictions for Venturi-type ejectors may be checked fairly well with experimental results. Applications where the primary or driving fluid is exhaust gas, such as in the diesel engine, are subject to a straight-forward analysis, and may have practical use in diesel auxiliaries.

After dinner speaker John Dunlop, principal of the Loucks School in Peoria, told of impressions gained while he was an exchange teacher in Ireland. His subject was, "A Look at **Irish Industry.**"

Technical chairman of the meeting was E. J. H. Bentz, supervising engineer of Caterpillar's research department.

Northwest

Field Editor
W. M. Brown
Dec. 4

ANECDOTES and reminiscences were exchanged by seven long-time Section members during a panel discussion of the development of the Section. Valentine Gephart, panel chairman, introduced members by giving a short biography of each man, including his **years of service** to the Society and his present work in the automotive field.

A letter from Tom Collins, past-chairman of the Texas Section, was read by Chairman Bob Norrie. Collins expressed his regret at not being able to renew **old acquaintances** with the panel members.

Colorado

Field Editor
P. G. Anderson
Nov. 19

FINDING OIL today is less of a gamble than it has been in the past. That was the opinion of Earl Brookshire who is operations assistant at Shell Oil's Rocky Mountain Division.

He said that the odds of discovering oil in wells drilled for that purpose has been reduced from 100/1 to 9/1. This is possible because **seismograph surveys** are used before drilling is begun.

A film was shown about the automotive equipment used to transport the surveying instruments over difficult terrain.

Dec. 17

"**NET PROFIT** of dieselized railroads varies directly with the engine lubricant used," L. C. Atchison said. Atchison is assistant engineer of tests of the Denver & Rio Grande Western Railroad. He said, too, that there is a definite correlation between the lubricant used and **maintenance required.**

After a tour of the railroad's shops, Atchison explained methods used to determine the internal condition of engines by **periodic analyses** of lubricating oil samples. Because of the complete data collected, the effects of various lubricants on engines can be compared. Results show that not only is a lubricant of a certain specification satisfactory, but that best results are obtained if the lubrication is refined at one particular refinery.

Wichita

Field Editor
W. E. Shelor
Dec. 9

WORLD PEACE must come from a better understanding of the other fellow's language, culture, and religion. This is what Victor Moore, assistant director of TWA's **Air World Education** Department, told members at this meeting.

In treating his subject, "The Fiftieth Anniversary of Powered Flight and Trends for the Future," Moore discussed personal experiences of his own travels. He cited the airplane as a contributing factor toward a **better understanding** among men. But he also warned of the fate in store if men should resort to using weapons.

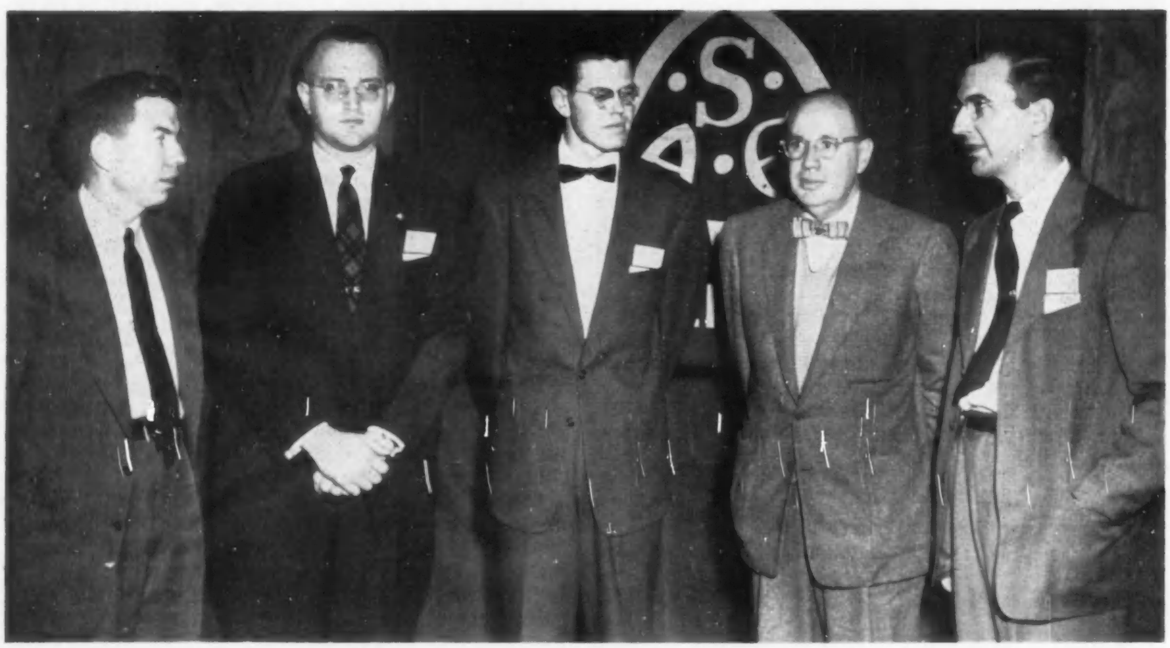
The meeting was a cooperative affair sponsored by the SAE and IAS. Host for the social hour was the Air Supply Co., and toastmaster for the evening was Phil McKnight.

From Section Cameras

Atlanta Group (Dec. 11)

SMILING at photographer is SAE's 1953 president, Robert Cass, who stopped in at this meeting.

Central Illinois (Dec. 14)



THREE SPEAKERS were on hand at the December meeting. They were N. K. Lammers (second from left); H. R. Moos, (to the right of Lammers); and John Dunlap, second from right. Section Chairman R. E. Kennemer is at the extreme left and Technical Chairman E. J. H. Bentz, is at extreme right.

Philadelphia

Field Editor
L. F. Dumont
Nov. 11

COMMON SENSE and artistic proportioning, as well as engineering talent, are necessary to design the **modern racing car.** This was the opinion of Robert T. Jackson who presented his paper, "Indianapolis Racing Car Design." Jackson is sales engineer for the Perfect Circle Corp.

He pointed out foreign influences on racing cars and gave reasons for **current trends** in chassis and engine design. Variations in the design of transmissions, suspensions, brakes, and other frame and chassis components were also covered after Jackson illustrated several basically different models of cars used in the Indianapolis Race. The description of the Meyer-Drake four-cylinder 270 hp engine was a highlight of the discussion.

The meeting was the Section's annual Student Night Dinner-Meeting. About 200 members and 100 student guests attended.

Field Editor
Paul Kennedy
Dec. 9

DRIVING TECHNIQUE and mechanical "tricks" in the Mobilgas Economy Runs have become almost completely neutralized because of latest rulings. H. S. Kelly told members the purpose of the contest is to show the public the mileage that can be obtained from cars that are properly driven. Kelly is product engineering manager in Socony-Vacuum's marketing department.

In 1950, he said, the run was a test of **tuneup procedure** and parts selection. In '51 the AAA selected the cars, eliminating the possibility of tuning. The result was that driving technique was a "telling factor." Contestants practiced for weeks over the course, using vacuum gages and other instruments to map the best driving method for each portion.

The following year the actual route was kept secret until the contesting autos were impounded by the AAA. Special **carburetor jets** were no longer allowed. By '53 the rules were such that the trends in the economy of various cars, engines, and transmissions could be measured.

Though conditions of the driving route are as varied as one is likely to find driving anywhere in the country, Kelly said no claim is made that "stop-and-go city drivers" should expect to equal economy run figures.

Jan. 6

COMMERCIAL AIRLINES in the U. S. are waiting for gas turbines not yet under development in this country. This is what W. R. Lawrence and Harold Hoben told a meeting of SAE and IAS members. Lawrence is director of development and Hoben is director of transport engineering for American Airlines.

Studies they have made indicate that both the turboprop and turbojet could be made profitable with more development. But, problems of runway length, noise, engine control, reliability and vibration are still to be solved. As for **helicopter shuttles** between outlying airports and urban centers as an answer to ground noise and runway length, Hoben said that cities seem to envelop such airport sites quickly.

Both Hoben and Lawrence indicated that ducted fan and gas coupled turbines might have potential uses. They lean toward pod mounting of engines and shy away from **delta wing** configurations for subsonic speeds.

Northern California

Field Editor
R. Gray
Dec. 9

THE FIRST MAN to crack the sound barrier and thus the first to fly faster than sound was Major **Charles E. Yeager,** who was speaker at this meeting. Yeager was voted "Airman of the Year" for 1951 and has received both the Mackay Trophy and the Collier's Trophy. The Collier award was presented to him by the president of the U. S. in 1948.

Yeager told members about his experiences in the **rocket-propelled** Bell X-1, a special research plane. In it, he obtained a range of climb of 13,000 ft per min—exceeding **the speed of sound** during ascent

Buffalo

Field Editor
D. I. Hall
Dec. 10

"**MIRACLE FABRICS**"—nylon, orlon, and dacron were of interest to attenders of the annual "Ladies Night." Leonard H. Schick described the **uses and manufacture** of these fabrics. He's with E. I. du Pont's Product Information Section, Textile Fibers Department. A dinner was served for those present.

Elliott Chapman, section chairman, gave membership awards to Edward I. Rusk for 35 years, and to: O. A. Hansen, J. R. Holmes, Randolph F. Hall, and William A. Clare, each for 25 years.

British Columbia

Nov. 9

"**WHEN YOU'RE SICK,** you rush to get a doctor . . . but when the bill comes you kick to beat the devil." Like health, service is conflicting, irritating, complex, necessary, desirable, . . . and expensive. That's what D. L. Kagy told members at this meeting. Kagy is general service manager for the Buda Engine Co., Harvey, Ill.

He said that manufacturers and dealers say, "We must have good service if we're going to **get sales.**" Yet, he said, the service department suffers from lower pay than most departments.

According to Kagy, the most important single phase of service is "the human factor." He said

Western Michigan (Dec. 1)

WILLIAM H. KENNEDY, chairman of the Section (standing) introduces Speaker A. B. Willi (to the right of Kennedy). Willi is executive vice-president of Continental Motors Corp.'s military plant, and at the extreme right is Bine Rollins, meetings chairman.

Philadelphia (Nov. 11)

POSING for cameraman are: Front row: (l to r) L. F. Dumont, student activity chairman and technical chairman; R. T. Jackson, speaker; and Section Vice-chairman A. M. Miley, who was also chairman of this meeting. Students who attended the meeting are: Second row: C. Albrecht of Drexel Institute of Technology; W. H. Fields, Pennsylvania Military College; N. Hughes, University of Delaware; M. Levene, University of Pennsylvania; F. E. Campagna, Lehigh University; M. A. Lindeman, student activity chairman. Third row: F. Evans, Haverford College; C. Kennedy, Swarthmore; W. J. Miller, Villanova; R. P. McCrea, Lafayette College.

that one survey shows that over 65% of **engine failures** are caused by the user. An Ethyl Corp. survey indicates 98% of mechanical trouble is not caused by fuels or lubricants, or the manufacturer. Thus a great deal depends upon the mechanic and the driver.

Texas Gulf Coast

Field Editor
W. B. Tilden
Dec. 11

THE TRANS-MOUNTAIN pipe line that runs from Edmonton, Alberta, to Vancouver, British Columbia, took two years just to be surveyed. Another two-and-a-half years were spent on actual construction. This was what G. T. Williamson told members. He is with the Midwestern Constructors in Tulsa, Okla.

Williamson said that the **24-in. line** with its four pumping stations can handle **300,000** barrels of crude oil per day. It would take **2,100,000** barrels of crude oil to fill the line at an approximate cost of **$5,000,000.**

Metropolitan

Field Editor
Leslie Peat
Dec. 10

"**PRACTICAL APPLICATION** of the air spring suspension to trailer units has caused considerable customer demand for the same application to trucks and truck tractors." That was what C. O. Slemmons told Section members. Slemmons is chief production development engineer at the General Tire & Rubber Co., Akron, Ohio.

He said, "We believe that the solution of this problem should be worked out by the individual truck manufacturers. They can draw upon our experience with these units and incorporate the basic **spring components** in their vehicles, each in his own way. Certainly by materially reducing the spring rate, they can take a big step forward in providing **more comfort** for the driver and longer trouble-free truck service.

Slemmons said that "the development of this suspension came about as a result of the management at the General Tire & Rubber Co. being interested in any product which will be helpful to the fast-growing trucking industry.

"They feel that any contribution to the suspension system will ultimately result in more demand for truck tires, the product which has made the miracle of modern transportation possible.

"Therefore, when an inventor came to them for help in producing the rubber parts, they became so enthusiastic that they assumed financial responsibility for the development of the complete air suspension."

Section members who attained 35 and 25 years of membership in the Society were introduced by William P. Kennedy, life-member ('05) and the Section's first chairman. Certificates for 35 years were received by: George C. Autenreith, William E. Day, Jr., and Loyal G. Tinkler.

Awards for 25 years were given to: Oswin Haucke, Walter R. Herfurth, Nelson G. Kling, Howard K. Porter, Walter S. Rainville, Jr., and Isadore Silverman.

The pioneer members were seated at a special table and were joined by Miss Judy McCormick of the SAE Headquarters staff and John A. C. Warner, secretary and general manager. Miss McCormick, who had served as Kennedy's aide during his tenure as chairman, received enthusiastic applause.

Field Editor
S. G. Tilden, Jr.
Dec. 16

ONLY THE RIGHT FOOT is needed to drive today's cars. That's what E. E. Hupp, development engineer at the Bendix Aviation Corp. told members.

"Now it is possible to operate accelerator and brake pedals with the right foot without even lifting the heel of the foot from the floor. **Brake-pedal height** and travel have been reduced so that the brake-pedal pad is at approximately the same level as the accelerator. This improvement has been made possible by the use of **vacuum power** to assist in the application of the vehicle brakes."

He said that the power assist unit is directly attached to the underside of the toe board so that actuation is direct, without intermediate linkage. Size is such that required **pedal effort** is actually less than that needed with the standard system. The power unit does approximately 2/3's of the work in applying the brakes."

S. G. Tilden of S. G. Tilden, Inc., Brooklyn, N. Y., and W. R. Williams of Bendix Aviation, then presented a discussion of the paper. The meeting was sponsored by Met Section's Passenger Car and Body Activity.

Twin City

Field Editor
S. H. Knight
Dec. 9

"**FATIGUE PROPERTIES** of materials and parts" was presented by Professor B. J. Lazan at a joint dinner-meeting with the ASME. Lazan is head of the University of Minnesota's Department of Mechanics and Materials. He is a member of Tau Beta Pi, Phi Beta Kappa, Sigma Xi, ASME, ASM, ASTM, ASEE, SESA, and other engineering societies.

Some of the topics covered by Lazan were: Forces and other **Environmental Conditions** Leading to **Service Failure** in Materials and Parts; Types of Service in which Fatigue Stress is a Major Factor; Performing Fatigue Tests; and Procedures and Equipment for Laboratory and Field Fatigue Testing.

Washington

Field Editor
C. Janeway
Nov. 17

RESULTS OF NEVADA atom tests were not conclusive, but the condition of a car 3500-ft from the blast indicated little **internal damage.** This was what A. L. Haynes told the Section. Haynes is the assistant chief of research at the Ford Motor Co.

and was a member of the civilian delegation to the Nevada tests.

He said that little internal damage was indicated in the car 3500-ft from the blast when windows were closed. There was also **no serious collapse** of the car top.

A Ford Co. film, "Tomorrow Meets Today," was presented and Haynes described special skills and latest instruments necessary to solve tomorrow's problems now in the creation of automobiles.

Field Editor
Bert Ansell
Dec. 7

ROBERT CASS was on hand to present 35-year certificates to: Paul B. Lum, manager of the Washington branch of Autocar Sales and Service Co.; Admiral Emory Scott Land, president of Air Transport Association of America; Dr. Arthur S. Hawks, consultant; and Henry J. E. Reid, director of Langley Laboratory, NACA.

While visiting with Section members, the president expressed views on some of his **favorite subjects**—including the engineer's place in management and a "**low-priced**" **automobile** to serve suburbanites. Cass said he foresees a car of about 2200 lbs that has good performance. He said this car should be stripped of unnecessary items that add to the cost.

Indiana

Field Editor
W. A. Barnes
Nov. 19

PAST-PRESIDENT Ralph R. Teetor was present to introduce Robert Cass, 1953 president. Cass chatted with members and presented membership certificates to: S. L. Bradley, O. T. Kreusser, and W. H. Welch.

In presenting his paper, "Engineering Frontiers," Cass stressed that there is an increasing scarcity of certain materials because of **defense stockpiling.** He said that there is a necessity for the substitution of other materials in more plentiful supply. Cass said it often happens that the application of enginnering brains to a substitution problem finally results in a **product improvement.**

Kansas City

Field Editor
M. L. Werth
Dec. 15

A CHRISTMAS MEETING was held with all the fixings including a turkey dinner and prizes. Some of the gifts were pen and pencil sets, boxes of cigars, anti-freeze, 10-gal lots of gasoline, and a couple of cash awards.

Speaker for the evening was Herman Hartzell of GMC's Delco-Remy Division. Hartzell's subject was "**The Twelve Volt Story**" which he has previously presented to the St. Louis and Colorado Sections. He said that with a switch from the 6-volt electrical system to the 12-volt system there is **better ignition,** generator, and cranking motor performance. He said, too, that there is **improved electrical distribution.**

Dayton

Field Editor
E. R. Kunz
Dec. 8

A TOUR of the Columbus Transit Co.'s West Broad St. Facility was the program for the Section's December meeting. On hand to welcome members were: O. R. Hott, president of the company; C. A. Rorsh, superintendent of equipment; and George Ruble.

Rorsh explained equipment and **company operations** and Ruble discussed coaches and components. Several **trolley and motor buses** were placed over pits so that construction and operating mechanisms could be examined.

The tour was arranged by Harold W. Herring, vice-chairman of the Columbus area of the Dayton Section. After the meeting, the group was entertained at the Columbus Athletic Club.

St. Louis

Field Editor
A. W. Zub
Dec. 8

SHORTEST-LIVED parts of the diesel engine are the compression rings and the upper third of the cylinder walls, according to K. L. Hulsing. Hulsing is chief application engineer at the Detroit Diesel Engine Division of GMC.

Speaking before a meeting of SAE and ASLE members, he said that the use of more heat resistant alloy steels has helped to **prevent warping** and burning of exhaust valves. He said that engine life can be prolonged considerably by proper use of engine horsepower, speed, fuel and lubrication. "If an engine is bought with all of the accessories attached, it will always do a better operating job," he said.

New England

Field Editor
D. F. Donahue

YOU'LL BE INTERESTED TO KNOW that the New England Section is honoring two or more of its Past-Chairmen at each of its 1954 meetings. The first pair honored were Glenn S. Witham (Chairman for 1926–27) and J. F. Shannon (Chairman for 1943–44), who were greeted by many old friends at the Section's January 5 meeting.

SAE Student News

Pennsylvania State College

On December 11 Student Branch members made a trip to Wilmington, Delaware, for a guided tour of the General Motors Buick-Oldsmobile-Pontiac assembly plant. The group stopped first in the metal department where they saw the roof and rear quarter panel lowered onto the underbody. These had been welded previously into a unit. Members saw metal finishings put on the bodies so that there would be a smooth surface for the paint job. The car is painted according to the customer's order, and is fitted with accessories.

Of particular interest were the paint spray booths equipped with ventilation systems that remove fumes and paint particles from the employees' breathing area.

Fenn College

Students drove their automobiles over a 170-mile course from Cleveland to Akron, to Andover, and back in a fuel economy test, Dec. 5. The contest was sponsored by the Student Branches of both SAE and ASME.

Martin Kisel, Jr. was the winning driver. LeRoy Reeves was second and Russell Robison, third. All are engineering students. The contest was judged on fuel consumption per ton-mile, to equalize the various makes and models entered.

Kisel drove a '51 Ford V-8 and finished the course in five hours and 17 min. His average driving speed was 32.3 mph. Total gas consumption was 6.96 gal.

Reeves drove a '50 Studebaker Champion without overdrive and completed the run in five hours and six minutes, driving an average of 33.4 mph and using 6.54 gal of fuel.

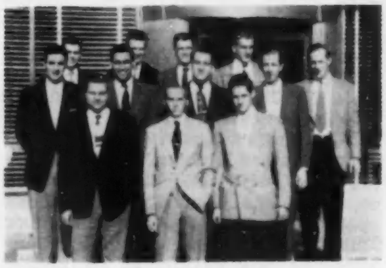
Robison's car was a '52 Aero Willys, driven at 33.4 mph. His consumption was 6.6 gal.

Adjusted consumption figures were: Kisel, 46.8 ton-miles per gal; Reeves, 46.1; and Robinson 40.7. The "Economy Trophy," donated by Fenn's mechanical engineering faculty, was awarded the winner. Second and third place winners also received trophies. The Fenn Economy Run is patterned after the Mobilgas Economy Run and is slated as an annual event.

General Motors Institute

The Student Branch at the General Motors Institute has already had an active schedule during the first half of this school year. "SAE Membership Week" was acclaimed twice, once in October and then again in November. Over 200 young men joined as a result of the campaign. The drives were climaxed by an evening meeting at which new members were introduced

Penn State



Penn State branch members are posed outside GMC's Wilmington, Del. plant. Front Row (left to right): William Scanlon; Paul Herr; Frank Cingel, Second Row (left to right): Samuel Lestz; John Hahn; George Alleman; James Decker, faculty adviser; Third Row (left to right): John Shaver; Gordon Thomas; Thomas Hoover; Don Civitella; George Whitmore

General Motors Institute

GMI branch members examine Chevrolet's new sports car, the Corvette, at a sneak preview, Nov. 24.

Fenn College

Martin Kisel, Jr. receives trophy for winning Fenn College's "economy run," Dec. 5. Presenting the award is Prof. Chester Kishel of the Mechanical Engineering Dept.

to officers, refreshments were served, and an active schedule planned.

On November 23 members toured the AC Spark Plug Division of GM. They observed die casting operations and heat treatment of spark plug insulators, the machining of the plug body, and the assembling of component plug parts. The following day the students were present in the GMI amphitheater to hear Z. Arkus-Duntov speak about Chevrolet's sports car, the Corvette. Duntov is staff engineer with the Chevrolet Research and Development Section.

V. P. Mathews, chief engineer of the Buick Motors Division, discussed the '54 Buick with SAE Student Branch members last January 8. Mathews spoke about many features of the new Buick such as the return of the Century line, V-8 engines in all models, higher horsepower, new front-end geometry, improved ventilation system, and—nonsqueal tires.

To supplement the talk a Buick Super Riviera was shown. A movie and slides about new Buick performance were also shown.

At the Branch's first dinner-meeting of the year, Howard H. Dietrich presented his paper, "Carburetion Principles and Automotive Applications." Dietrich is a staff engineer with the Rochester Products Division of GMC.

Officers for the year are: Chairman Dick Bradfield, Vice-Chairman Byron Richards, Secretary-Treasurer Bob Annis, Program Chairman Burt Arbuckel, and Field Editor Bob Johnson.

Aeronautical University

On Friday, October 30, a joint meeting of the SAE and IAS Student Branches was held at the Aeronautical University. The respective chairmen, Robert Samuelson and James Siller, presided. Samuelson opened the meeting and welcomed members.

Three outstanding movies were shown—"Ceiling Unlimited" (This depicted the progress of aviation from its birth to the present.), "Blueprint for Your Future," (This told how a "green" engineering graduate started his career in aviation.), and "Danger River," (An account of an expedition down the dangerous Colorado River of the Grand Canyon). The films were loaned by the Socony-Vacuum Oil Co., The McDonnell Aircraft Corp., and the Santa Fe Railroad, respectively.

The program was sponsored by the SAE students.

Students Enter Industry

Continued from Page 75

D'ARCY M. HOOPS (General Motors Institute '53) is a methods engineer in the Fisher Body Division of General Motors, Flint, Mich.

RUSSELL JAMES LIMER (Purdue '53) is a field service representative for the Service Division of the Cummins Engine Co., Columbus, Indiana.

WILLIAM PAUL PANNY (Chrysler Institute '53) is now a staff engineer for Chrysler Corp., Detroit.

ROBERT DARYL STRASZHEIM (Purdue '53) is with the Standard Oil Co. of Indiana, Automotive Research Division. He is an automotive engineer.

ELLIOT R. THOMPSON (Michigan College of Mining & Technology '53) is an experimental test engineer for Pratt & Whitney Aircraft, Division United Aircraft Corp., East Hartford, Conn.

WILLIAM B. GORDON (Wayne University '51) is now a quality standards specialist with the Ford Motor Co., Dearborn, Mich.

ROBERT DOUGLAS INGLIS (California Institute of Technology '53) has joined G. O. Noville & Associates, Inc., Los Angeles, as a test engineer.

GAIL C. ROSS (California State Polytechnic College '53) is now a machine designer with Fibreboard Products, Inc., Antioch, Calif.

ROBERT A. ROGERS (Michigan State College '53) is an engineer in training at the General Motors Proving Ground, Milford, Mich.

JAMES H. FRYE, (Chrysler Institute '53) is a second lieutenant in the U. S. Air Force stationed at the Wright Air Development Center, Dayton, Ohio.

CASIMIR BIEBERS (Academy of Aeronautics '53) is a technician with the Republic Aviation Co., Inc., Farmingdale, N. Y.

WILSON D. DYSART (Purdue University '53) has joined the Cummins Engine Co., Inc., Columbus, Indiana, as a test engineer.

SAUL KUSHNICK (New York University '53) is now a development engineer with the Manning Maxwell & Moore Co., Stratford, Conn.

DONALD I. ROHRBACH (Michigan College of Mining & Technology '53) is now enrolled in the Graduate Training Program, Truck Section, at the Ford Motor Co., Dearborn, Mich.

ROBERT A. STOUGH (University of Pittsburgh '53 has joined the Westinghouse Air Brake Co., Wilmerding, Pa., as a junior design engineer.

BOB D. BROWNING (Parks Air College '53) is now an engineer with the Cessna Aircraft Corp., Wichita, Kansas

JOHN FARLEY THORNE, JR. (Purdue University '52) is now a second lieutenant in the U. S. Air Force stationed at St. Paul, Minn.

CARLE C. CONWAY III (Massachusetts Institute of Technology '53) is a design engineer with the Aerojet-General Corp., Azusa, Calif.

GEOFFREY A. ECKLES (Yale University '53) is a research engineer with the United Shoe Machinery Corp., Beverly, Mass.

BERT HALE, JR. (Northrop Aeronautical Institute '53) has joined the Ryan Aeronautical Co., San Diego, as a research lab analyst.

EDWARD C. HOLMBLAD (University of Illinois '53) is now a junior engineer with the Fisher Body Division of GMC, Detroit.

THOMAS M. IRVINE (Purdue University '53) is a junior engineer with the Boeing Airplane Co., Seattle.

HENRY J. JOHNSON, JR. (Northrop Aeronautical Institute '53) is now an engineering assistant with the United Aircraft Corp., East Hartford, Conn.

MARCUS H. PHILLIPS III (Rensselaer Polytechnic Institute '53) is an industrial engineer with the Eastman Kodak Co., Rochester, N. Y.

BERT R. SMITH, JR. (Chrysler Institute '53) is now a test and development engineer with the Chrysler Corp., Detroit.

DAVID WILLIAM KERR, JR. (Missouri School of Mines and Metallurgy '53) is now assistant manager with Fonda Gage Inc., Ponce, Puerto Rico.

WILLIAM JAMES EUBANK (Michigan State College '53) has joined the Ford Motor Co., Dearborn, Mich., as an engineering trainee

WILLIAM C. DRIES (University of Wisconsin '53) is a civil-mechanical engineer assistant with the U. S. Army, Fort Monmouth, N. J.

GORDON WILLIAM MORGAN (California Polytechnic College '53) has joined the Stevenson Equipment Co., Inc., Santa Rosa, Calif., as a power and equipment engineer.

A. GORMAN DORSEY, JR. (Johns Hopkins University '53) is a development engineer for the Bakelite Co., Bound Brook, N. J.

GENE GORDON ENGEL (Michigan State College '53) has joined the Fisher Body Division of GMC, Lansing, Mich., as engineer data analyst.

EVERETT H. FIELDS (University of Illinois '53) is now a project engineer in the experimental dept. of the Ford Motor Co., Dearborn, Mich.

XAVIER W. FRANZ (Carnegie Institute of Technology '53) is a tool designer for the Fisher Body Division, GMC, in McKeesport, Pa.

JOHN D. KOETTER (Bradley University '50), now out of the armed services, is sales engineer at Minneapolis-Honeywell Regulator Co., Peoria, Ill.

STANLEY C. SQUIRES (University of Pittsburgh '53) is an engineer in the power development section, Pontiac Motor Division, GMC.

EDGAR D. JONES (Case Institute of Technology '51; Chrysler Institute of Engineering '53) is a staff engineer in truck engineering, Chrysler Corp., Highland Park, Mich.

JAMES J. RYAN, JR. (Parks College of St. Louis University '53) is spare parts planner with McDonnell Aircraft Corp., St. Louis, Mo.

ANDRE C. MARTIN (Massachusetts Institute of Technology '53) is a teaching assistant in the department of aircraft engines, Institut de Mecanique, Liege, Belgium.

RICHARD C. HILL (University of Illinois '53), is a junior research engineer at North American Aviation, Los Angeles, Calif.

THOMAS J. HARDCASTLE (Southern Methodist University '53) is a technical engineer at the A.G.T. Division Evendale Works of General Electric Corp., in Cincinnati, Ohio.

RUSSELL O. deCASTONGRENE, JR. (Purdue University '53) in November was at the Aviation Ground Officers School in Jacksonville Florida. He had been commissioned an Ensign when he graduated from OCS Newport, R. I.

MANFRED KLUTH an under graduate at Technische Hochschule, Munich, Germany, is functioning as German editor for "Design News" published in Detroit by Rogers Publishing Co.

HARRY C. PROBST (Purdue University '53) is an assistant project engineer at Kiekhaefer Aeromarine Motors, Inc., Oshkosh, Wis.

SAE National Production Meeting

March 29-31, 1954

The Drake, Chicago, Illinois

will be keyed to the theme of

"Production-Design Partnership"

This three-day meeting will serve up a varied, interesting fare. Its highlights:

- **PRODUCTION FORUM . . . Monday, March 29**
  Eight panels on vital production problems manned by leading engineers and manufacturing men.
- **TECHNICAL PAPERS . . . Tuesday, March 30**
  Focussed on need for greater coordination between engineers and production men.
- **TOP-NOTCH DINNER PROGRAM . . . Tuesday, March 30**
  With an entertaining, thought-provoking talk by Dr. Kenneth McFarland.
- **PLANT TRIPS . . . Wednesday, March 31**
  Two of Chicago's most interesting plants:
  Hotpoint and International Harvester's Melrose Park Works.

Students Enter Industry

continued

ANTHONY de BOURBON (Parks College '52) is an instructor for the Commercial Pilots Training School with the Real S/A, Aeroporto Congonhas, Sao Paulo, Brazil.

EDWARD T. WATSON, JR. (Parks College '53) is assistant manager of the Cedar Crest Farm, Independence, Mo.

RICHARD B. WYMAN (Tri-State College '53) is now a practice engineer with the Wheeling Steel Corp., Benwood, W. Va.

ERVIN ARTHUR KOTH, JR. (University of Wisconsin '53) is an engineer in the testing laboratory of The Heil Co., Milwaukee, Wis.

A. BERCHAR COPPENS, JR. (University of Illinois '53) has joined the General Electric Co., Schenectady, N. Y. as a test engineer.

AUGUST LEONARD CYROTSKI (University of Minnesota '52) is a student engineer with the Chevrolet Gear and Axle Division of GMC, Detroit.

JOHN LOWDEN DAWSON (California State Polytechnic College '53) is now an engineer with the General Electric Co., Cincinnati.

RALPH DEAN, JR. (Michigan State College '53) is an engineer in training at the General Motors Proving Ground, Milford, Mich.

JAMES W. DOYLE, JR. (Parks College of Aero Technology '53) is now an engineer with the Cessna Aircraft Co., Wichita, Kans.

RICHARD A. DUNBADEN (Academy of Aeronautics '53) is now an instructor of riveting and aircraft assembly at the Casey Jones School of Aeronautics, Farmingdale, N. Y.

ANTHONY D. FRAGOMENI (Parks College '53) is a technical writer with the Grumman Aircraft Engineering Corp., Bethpage, N. Y.

DOUGLAS W. HAIG (Parks College '53) has joined the Bendix Aviation Corp., South Bend, Ind., as a landing gear engineer.

THOMAS E. LAMBERT (University of Michigan '53) has become a mechanical engineer for Ingersoll-Rand, Painted Post, N. Y.

JOHN W. NORDENSON (University of Minnesota '53) is a product engineer for the Minnesota Mining & Mfg. Co., St. Paul, Minn.

GEORGE M. PARK, JR. (Bradley University '53) has become a civil engineer with the Illinois Division of Highways.

JOHN ANTHONY SACCHERI (Academy of Aeronautics '53) is employed by the Curtiss-Wright Corp., Wood-Ridge, N. J.

RAUL A. STERN (University of Wisconsin '53) is now an engineering trainee at the Cummins Engine Co., Columbus, Indiana.

WILBUR R. WIRTZ (Oregon State College '53) is employed as a mechanical engineer by the California Steel Products Co., Richmond, Calif.

FRITZ C. RUNGE (General Motors Institute '49) is with Chrysler Corp., Detroit, as a test and development engineer.

Students Enter Industry

continued

WILLIAM A. RICHARDS (Michigan College of Mining & Technology '53) is now a junior engineer "B" in the Boeing Airplane Co., Seattle.

JAMES RAMSAY (Northrop Aeronautical Institute '53) is with the Boeing Airplane Co., Seattle. He is a methods engineer.

BRUCE R. WARN, JR. (Rensselaer Polytechnic Institute '53) is now a student engineer in the Ingersoll Rand Co., Painted Post, N. Y.

IVER RICHARD EVERSON (Rensselaer Polytechnic Institute '53) is a research engineer for Ford Motor Co., Dearborn, Mich.

HERBERT Y. ENDO (Purdue University) has joined North American Aviation, Inglewood, Calif., as an engineering draftsman "B".

PETER REGINALD ANGELL (Chrysler Institute '53) is a research engineer for Chrysler, Detroit.

MYRON M. DAILY (Bradley University '53) has joined Caterpillar Tractor Co., Peoria, Ill. He is in the engineering department doing follow-up and design work.

WENDELL D. McGRATH (Michigan State '53) is a dynamometer operator with Ford Motor Co., Dearborn, Mich.

TRAVIS P. ESKRIDGE (Northrop Aeronautical Institute '53) has joined North American Aviation, Downey, Calif. He is a draftsman "B".

LLOYD I. KRAUSE (University of California '53) is now a junior test engineer at Pratt & Whitney Aircraft, East Hartford, Conn.

HAROLD N. WEINBERG (University of Florida '50) is employed as a mechanical engineer by the Standard Oil Development Co., Linden, N. J.

DONALD E. MEYER (Michigan State College '53) is at the Ordnance School, Aberdeen Proving Grounds, Aberdeen, Md.

CHARLES A. STODDARD (Massachusetts Institute of Technology '53) has been called to active duty with the U. S. Air Force. He was an engineer for Thompson Products, Inc., Cleveland.

JOHN S. YOUNG (Stevens Institute of Technology '52) is a mechanical engineer in the ballistic research laboratories of the U. S. Army, Aberdeen Proving Grounds, Md.

RICHARD R. HAREMSKI (General Motors Institute '53) has joined the General Motors research laboratories, Detroit, as a junior engineer.

EARL G. SIEVERKROPP (University of Wisconsin '53) has entered the U. S. Army and is a mechanical engineer.

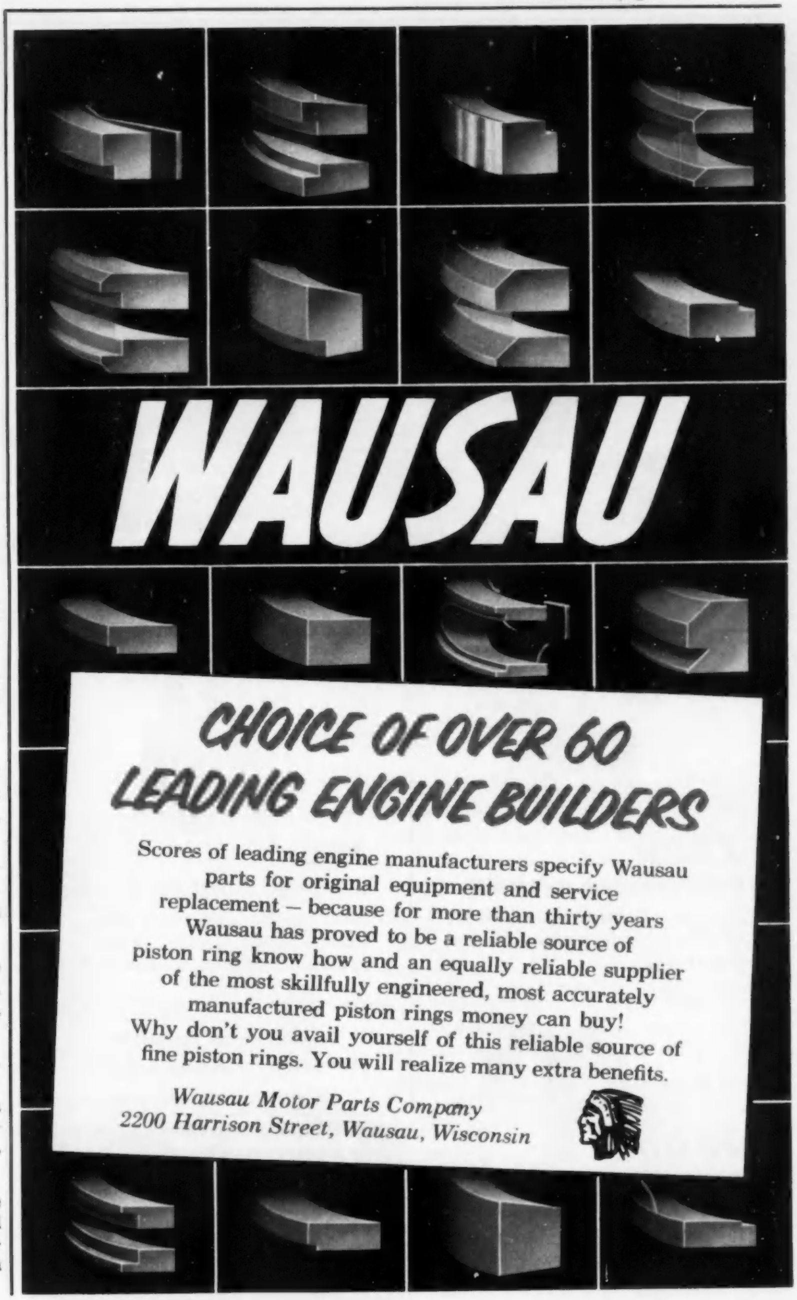
THOMAS L. KOEDERITZ (Missouri School of Mines & Metallurgy '53) is a platoon leader in the U. S. Army. He was with the Magnolia Petroleum Co.

BENJAMIN ANDREW SLUPEK (Case Institute of Technology '56) is employed as a development engineer by Euclid Road Machinery Co., Euclid, Ohio.

ARTHUR GRUETJEN (Northwestern University '51) has joined the Ford Motor Co., Dearborn, Mich., as a financial analyst.

WALTER SCOTT, JR. (New York University '53) is a junior engineer for Arma Corp., Mineola, N. Y.

Continued on page 100



Students Enter Industry

continued

WILBUR R. WIRTZ (Oregon State College '53) is employed as a mechanical engineer with the California Steel Products Co., Richmond, Calif.

ALFRED S. JOSSI (Wayne University '53) is a test and development engineer for Chrysler, Highland Park, Mich.

THOMAS OSTERS (Case Institute '53) is with the Cleveland Graphite Bronze Co., Cleveland, as an assistant product engineer.

DONALD S. PERRY (Fenn College '53) is employed as a product engineer by the Electric Auto-Lite Co., Toledo.

RONALD W. BENNETT (General Motors Institute '54) is completing his fifth year program. He is with the Delco Products Division, GMC, Dayton, Ohio.

GORDON J. WILLMON (University of British Columbia '53) is now an engineering trainee for Imperial Oil, Ltd., Devon, Alberta, Canada.

JERRY C. RUSSELL, JR. (Northrop Aeronautical Institute '52) has joined the Piasecki Helicopter Co., Morton, Pa., as a layout draftsman.

RONALD C. HERZOG (Academy of Aeronautics '53) is with the experimental department of Republic Aviation, Farmingdale, N. Y.

CHESTER P. ZELACHOWSKI, JR. (University of Pittsburgh '53) has joined North American Aviation, Inc. in Columbus, Ohio, as a junior engineer.

RAYMOND E. ALDEN (University of Miami '53) is a design engineer for the Worcester Automatic Rebuilding Co., Worcester, Mass.

RAYMOND L. RUBEY (Illinois Institute of Technology '53) is a sales engineering trainee for the Pyle-National Co., Chicago.

RAY W. SEVAKIS (Lawrence Institute of Technology '53), previously a tool engineer, is now shop superintendent for the Langlois Tool & Die Corp., Detroit.

CASPER J. SZUKALSKI, JR. (California State Polytechnic College '53) is with the Owens Corning Fiberglas Corp., Santa Clara, Calif., as a design engineer.

LYLE E. HIATT (Northrop Aeronautical Institute '53) is now employed by North American Aviation, Inc., Downey, Calif., as a draftsman.

LOUIS KALBERMAN (Academy of Aeronautics '53) is a template maker for the Grumman Aircraft Engineering Corp., Bethpage, N. Y.

JEROME LIEBOW (University of Michigan '53) is with the Packard Motor Car Co., Detroit, as a junior detailer.

WILLIAM P. MOORE (The Pennsylvania State College '53) has joined The Kelly Springfield Tire Co., Cumberland, Md., as a junior engineer.

JOHN A. MAJANE (Rensselaer Polytechnic Institute '53) is a manufacturing trainee at the Radio Corp. of America, Victor Division, Camden, N. J.

WILLIAM F. MULLALY (Lawrence Institute of Technology '53) is in the styling section of General Motors, Detroit, as a layout man.

Students Enter Industry

WILLIAM V. OAKENELL (Stevens Institute of Technology '53) is a management trainee at the Fairless Works of United States Steel Co., Morrisville, Pa.

R. CHELLAPPA (Madras Institute of Technology, '53) is an engineering apprentice with Messrs. Simpson & Co., Ltd., Madras, India.

RAYMOND M. COLE (Penn State '54) is with GMC's research laboratories, Warren, Mich., as a junior engineer.

H. E. COLLICOTT (Purdue University '51) is a flight test engineer for Boeing Airplane Co., Seattle.

WALTER J. EAGER, JR. (California Institute of Technology '53) is with the Foods Machinery and Chemical Corp., San Jose, Calif., as a junior design engineer.

ANTHONY FORTINI (Purdue University '53) is an aeronautical research scientist with the National Advisory Committee for Aeronautics, Cleveland.

RAY W. SEVAKIS (Lawrence Institute of Technology '53) is a shop superintendent in the Langlois Tool & Die Corp., Detroit.

GORDON J. WILLMON (University of British Columbia '53) is now an engineering trainee with Imperial Oil, Ltd., Alberta, Canada.

ANDREW JAMES RUDDELL (Academy of Aeronautics '53) has become an instructor at the Casey Jones School of Aeronautics, Farmingdale, N. Y.

HAROLD W. WHALEN (Northrop Aeronautical Institute '53) is a stress analyst "C" for North American Aviation, Inc., Downey, Calif.

WINTON G. HAMMOND (Purdue University '49) is a captain in the U. S. Air Force. He is a communications and electronics officer.

LOUIS E. BOTHELL (State University of Iowa '53) has become a staff member of the Sandia Corp., Albuquerque, New Mexico.

WILLIAM B. GORDON (Wayne University '51) is with the Quality Control Division of Ford Motor Co., Dearborn, Mich., as a quality standards specialist.

ROBERT R. FLINN (University of Cincinnati '53) is now a junior engineer with the Fisher Body Division of General Motors, Hamilton, Ohio.

HENRY H. HART (Northrop Aeronautical Institute) is an engineer in the Assembly Group of Westinghouse Aircraft's Gas Turbine Division, Kansas City, Mo.

H. RUSSELL KUNZ (Rensselaer Polytechnic Institute '53) has become a junior analytical engineer for the Pratt & Whitney Aircraft Co., East Hartford, Conn.

WILLIAM P. MOORE (Penn State College '53) is now a junior engineer for the Kelly Springfield Tire Co., Cumberland, Md.

LOUIS KALBERMAN (Academy of Aeronautics '53) is employed as a template maker by the Grumman Aircraft Engineering Corp. of Bethpage, L. I., N. Y. He is also studying for his aeronautical engineering degree at Adelphi College.

DONALD O. PEARSON (Utah State Agricultural College '53) has joined the Birch-Lytle-Green Construction Co., Anchorage, Alaska, where he is employed as a mechanic.

Tractor Testing

continued from page 80

SAE Standard for Tractor Drawbars.

If the Nebraska test is to reveal accurately small differences in performance, provision must be made to test all tractors under as nearly identical atmospheric conditions as possible. The influence of atmospheric conditions is often greater than the difference in performance that can be secured between two tractor models. If our engines would always follow established correction formulae in all respects—this provision would not be important. However, there seems little likelihood of this happening or of all interested parties reaching an agreement on suitable corrections for all data reported. Since we cannot control weather, it appears best to cope with it by providing proper facilities for securing a maximum of data during the desired atmospheric conditions. This might be done by expanding laboratory personnel, and paying overtime during test rush periods.

Loss of time waiting for the track to dry and be put into condition after rains, might best be overcome by constructing a new hard surfaced track for pneumatic tired equipment, and use the present dirt course for crawler and steel-wheeled equipment.

The foregoing suggestions would increase operating expenses and capital investment. This added burden should be financed by the people using the service—the farmer and the manufacturer. From a practical standpoint the tractor manufacturer will pay the bill and pass it on to his customers as part of the tractor cost.

M. J. Samuelson

Minneapolis-Moline Co.

To many in industry, a concrete testing course would enable the test to obtain more consistent data and reduce time and delay. If a hard surface cannot be provided, then the earthen track should be conditioned to hold the range of variations to more tolerable limits.

It seems reasonable that drawbar heights be held within the limits of ASAE standards.

Weight is basic to drawbar pull. It must either be added to the tractor, or the drawn tillage tool must be designed to place its vertical force components on the traction wheels. Since methods employing transfer of vertical force cannot be used, there is no alternative but to add ballast for reasonable drawbar pulls.

Until some acceptable standardized datum weight level limit is established, it should remain the manufacturer's prerogative to choose the drawbar pull limits he believes his tractor is capable of performing. The user must do as was done on a Nebraska test to get comparable performance, or he must use tools and devices designed to achieve the same purpose.

Aids Technical Approach to Service

Based on paper by

LEWIS C. MECKLENBURG

Ford Motor Co.

TODAY'S cars and trucks are capable of giving years of satisfactory service long after they cease to be new models, if they are properly serviced by mechanics trained in the best methods and using the right parts and tools. To further such service, the Ford

Division has a new Technical Service Laboratory. It will implement the technical approach by enabling service operations to keep pace with the rapid advances which have been made in engineering and manufacturing methods. (Paper "Engineering, Sales, Service—Partners in Productivity" was presented at SAE Texas Section, Dallas, Sept. 18, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members; 60¢ to nonmembers.)

Crawler-type suspension offers the best traction and flotation. Traction is best because of the very large interference area—the track grouser has five times that of a rubber tire. Usually, there is 1 sq in. of track presented to the ground for every 5 or 6 lb of vehicle weight, resulting in a ground pressure of 5 to 6 psi.

Unexcelled traction makes the crawler ideal for plowing and deep tillage. The high drawbar pull at low speeds makes it superior for transplanting work. The combination of good traction and flotation makes it suitable for all land clearing operations, while its maneuverability, plus correct travel speeds, fits it for orchard work.

The relatively low travel speeds are a disadvantage. At high speeds the centrifugal forces developed by the

Campus Can Provide Much Needed Experience

Based on paper by

DOUGLAS C. WILLIAMS

Ohio State University

MOST employers want their employees to take active part in social and technical organizations. This involves committee work and there is no better place to begin acquiring experience in it than on the campus.

The broader your background of experience in human affairs, the better able you will be to communicate with your associates in getting them to pursue some course of action. As you become older you will be training people for the future.

What better goal can you strive for than to help your assistants see the desirability of broadening human experiences? Maturing requires a growing, which in turn involves a changing rather than a static situation. (Paper "What Is Expected of Engineering Graduates After Commencement?" was presented at SAE Student Branch, Ohio State University, May 21, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members; 60¢ to nonmembers.)

Crawler-Type Tractor Has Special Farm Role

Based on paper by

R. O. McSHERRY

The Oliver Corp.

THE proper role of the crawler-type tractor is to supplement the wheel-type on farms requiring two tractors, although it can serve as the first tractor on small specialized farms.

track mass cause a high rate of wear on component parts. Crawlers are banned from highways because of the track cleats, and that, too, is a disadvantage. (Paper "'Crawler' Purview in Agriculture" was presented at SAE National Tractor Meeting, Milwaukee, Sept. 16, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members; 60¢ to nonmembers.)

Tillage Tools Must Withstand Hard Usage

Based on paper by

W. D. McMILLAN

and

W. C. BLIESENER

International Harvester Co.

NO single tool will serve all tillage purposes. It takes many types, all of which can be grouped into two classes. One is the solid, rigid type which includes the moldboard plow; the other the spring temper, flexible tools such as a disk blade, which is a knife-edged cutting tool.

It takes more than just clean SAE 1085 steel to make a good disk. Disks are hardened and drawn to a hardness of 38 to 45 R/C, with requirements that these hardness values shall apply to the entire surface and cross-section. The physical properties of as-rolled steel are no match for those of the same steel quenched and drawn or isothermally quenched to the same hardness. Likewise, the differential of physical values, for example, of 33 R/C as-rolled and 38 R/C quenched and drawn is greater than of 33 and 38 R/C both obtained by heat treatment. This emphasizes the importance of complete austenitizing and thorough transformation.

A high percentage of harrow disks are blanked from strip which has been rolled at right angles to the rolling of the slab. Cross-rolled steel has been found to yield a better disk than straight rolled strip, and to lessen the possibilities of directional failure (splitting).

Plow disks are also made of SAE 1085 steel. There are some alloy plow disks, but the percentage of the total is small. The first alloy was very likely 3100 nickel chrome. More recently 4100, TS-4100-8600, TS-8600—possibly 80B60, have been used. In the past, 9260 silico-manganese was used, and may still be.

One of the requirements of a plow

disk is that it shall scour and to do this it must retain its original smoothness and polish to an appreciable degree. Because of the lower resistance to oxidation the silico-manganese disk lost the ability to scour satisfactorily, hence was less popular. Scouring is the term used to describe the smooth flow of earth over the surface of the disk.

Both carbon steel and alloy plow disks are heat treated to the same hardness values as plain harrow disks, 38 to 45 R/C. However, it is more of a job to produce good plow disks consistently than it is to turn out harrow disks if for no other reason than the polishing which is vital to the functioning of the former.

Manufacture of tillage tool disks might appear to be simple in view of the fact that there is practically one grade of steel used, that there is a fairly narrow range of hardness, and a marked similarity of shape and section, but production quantities alone complicate the process. Quality and uniformity stem from a well controlled practice right through the final grind. (Paper, "Tillage Tools—Material and Heat Treatment" was presented at SAE National Tractor Meeting, Milwaukee, Sept. 16, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members; 60¢ to nonmembers.)

Learning Curve Aids Aircraft Maker

Based on paper by

DEAN P. STOWELL

Canadair Limited

IN 1936, T. P. Wright made a basic contribution by identifying the rate of reduction in direct man-hour costs with increasing quantities of production in what is commonly known today as the learning curve. Writing in the Journal of the Aeronautical Sciences, he set forth 80% learning as being applicable to the aircraft industry. Not until 1942 did the industry as a whole come to accept his idea as sound.

The learning curve record of wartime and subsequent experience now exists for all types of aircraft, ranging from very heavy bombers to primary trainers. This experience shows there is enough difference in learning between aircraft types to be significant.

Time reduction trends in unit manhour costs generally can be represented best by a straight line drawn on double logarithmic paper. The vertical axis represents direct man-hour per plane and the horizontal axis represents cumulative production. The mathematical implication is that a constant

percent increase in the cumulative plane number is accompanied by a constant percent decrease in the unit hours. Thus, Wright's 80% learning curve implies that the doubling of the cumulative plane number results in reducing the unit man-hour expenditure to 80%, so that if 10,000 direct man-hours were expended on the 100th plane, cumulative plane number 200 would require 8000 direct man-hours.

It is often possible and desirable to analyze the aircraft by the types of labor comprising the total direct labor effort, since each type has its own learning curve. When these are combined in the proper proportion it provides an overall learning curve for the aircraft. Thus, when the producer is presented with a variety of typical learning curves, he must make a decision as to which one to use in estimating man-hour requirements. (Paper "A Plan for Airframe Production" was presented at SAE International Production Meeting, Toronto, Oct. 30, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers).

Some COE Cabs Need Better Design

Based on paper by

F. S. BASTER
and
C. H. FAGER

The White Motor Co.

HIGHWAY tractor cabs should be designed for safety and comfort. One of the first requirements is sufficient room. This offers no problem in the conventional type of truck. But in some of the COE designs, with engine doghouse forward of the seat, the driver's leg room is restricted. With the cab farther forward, the floor is clear of obstructions and compares favorably with the conventional.

Visibility should be inherently better in the COE type because the driver is in forward position and has no hood in front. In general, because of heavier front end loads, special design precautions must be taken to keep the ride as good as in the conventional type truck. However, with the cab moved forward, longer springs can be used, which helps the ride problem. (Paper "Some Design Elements for COE Highway Tractors" was presented at SAE National Transportation Meeting, Chicago, Nov. 4, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers).

Why Distillate Fuels Deteriorate in Storage

Based on paper by

F. G. SCHWARTZ

C. C. WARD

and

H. M. SMITH

Bureau of Mines

FORMATION of gum in fuels on storage is a long-standing problem. The gum is formed in two physical states: one type is dissolved in the fuel and cannot be filtered from it but can be recovered by evaporation of the fuel. This dissolved, nonvolatile material, called "soluble gum," is thought to be undesirable because it may be a precursor to formation of insoluble gum, which may contribute to injector sticking and engine deposits.

The second type of gum exists as a precipitate in the fuel. It is insoluble in the fuel and contributes to filter clogging and fouling of the fuel-injection system. This material, referred to as "insoluble gum," is believed to be the more harmful product of fuel deterioration in storage.

Storage stability studies, jointly financed by the Western Petroleum Refiners Association and the Bureau of Mines, were begun at the Bureau in May, 1951. Subsequently, the Bureau of Ships, Navy Department, contributed to certain phases of the work. On the basis of results obtained to date the following generalizations appear valid:

1. Straight-run fuels are the most stable, catalytically cracked fuels are intermediate, and thermally cracked fuels are the least stable.
2. Iron does not catalyze gum formation.
3. Copper catalyzes gum formation, especially in the presence of sea water.
4. Oxygen is necessary for gum formation.
5. Almost half the blends of fuel were incompatible after 39 weeks of storage at 110 F; several blends showed supercompatibility, and the other blends were compatible.
6. No blends showed immediate incompatibility.
7. Only fair correlation exists between storage at 110 F and storage at ambient temperature.

Some progress has been made on a study of the fundamental causes of instability and incompatibility, but the results to date do not warrant definite conclusions. (Paper "Studies on the Storage Stability of Distillate Fuels—Results of Storage Tests," was presented at SAE National Diesel-Engine Meeting, Chicago, Nov. 4, 1953. It is available in full in multilithographed form from SAE Special Publications

Department. Price: 35¢ to members; 60¢ to nonmembers.)

Based on Discussion

H. C. Hunter, Gulf Oil Corp.

We agree that soluble gum may precede the formation of insoluble gum or sludge, but some of us have seen no clear evidence of injector sticking troubles from operation on fuels containing an appreciable quantity of this "gum" as long as it is still in solution or ultra-fine dispersion in the oil. The point of this observation is that specification writers should not let any limiting values on "soluble gum" get into requirements for diesel or burner fuel oils.

W. deB. Bertolette, E. I. du Pont de Nemours & Co., Inc.

Our introduction to the problem of the harmful effect of copper was in the form of field complaints. Filter screens in diesel engines and fuel oil burners were restricted by waxy deposits which chemical analyses indicated to be primarily copper mercaptides. These mercaptides were found to form through a complex series of oxidation-reduction reactions in a hydrocarbon system which contains copper, or brass, mercaptan and an oxidized hydrocarbon. The most important reactions are believed to be: (1) the oxidation of elemental copper by hydroperoxide to copper ions, (2) reaction of copper ions with mercaptan to form copper mercaptide, (3) oxidation of mercaptan by hydroperoxide catalyzed by copper ions. The copper mercaptides formed vary widely in solubility, some, such as normal butyl mercaptide, are insoluble, and others, such as tertiary butyl mercaptides, relatively soluble. Therefore, the copper mercaptide may form a residue or may provide a means of solubilizing the copper. In its soluble form copper can exert its accelerating effect on the residue forming reactions in fuel oil.

This reaction, with the objectionable increase in residue formation, can be eliminated, and was in the field complaints mentioned. Any of the following steps are sufficient: (1) Remove or convert the mercaptans. (2) Reduce the formation of peroxides by minimizing contact with O_2. (3) Remove sources of or contact with copper, or, finally, deactivate the copper chemically.

W. A. Herbst. Esso Laboratories

Several points regarding the storage stability of distillate fuels should be brought out to avoid any misunderstanding of the conclusions drawn in the paper. Some of these are:

1. While the conclusions regarding the stocks under study at the Bureau are undoubtedly correct, they do represent data on unfinished stocks, and are, therefore, not truly representative of the type of material in use in the field as diesel fuel. The effect of

finishing (caustic washing, acid treatment, sweetening, and the like) on stability can be as important as the source and type of stock. Whereas, a component appears unstable prior to treatment, use of the proper finishing procedure can make it completely acceptable in storage stability.

2. Additives are finding increasing application in distillate fuels as stabilizers or dispersants for suspended sediment. Such stabilizing or dispersant-type additives can markedly improve the stability and/or performance of low-quality fuels or unstable fuel components.

3. The work to date by the authors has been concentrated on the effect of storage on the soluble and insoluble gum contents of the test fuels. While the effect of insoluble gum (sediment) on fuel system components is rather clearcut, the effect of the soluble gum, which passes all fuel filters, is still open to question. This gum could conceivably be responsible for injector sticking, assuming that it plates out at high temperatures as varnish, which ultimately causes seizure. The effect of the products of storage instability (that is, soluble gum, insoluble gum) on the performance of diesel engines has received little attention to date. While such studies are beyond the scope of the program being followed at the Bureau of Mines, the increasing importance of storage stability in distillate fuels indicates the need for work of this type.

Plug Fouling

continued from page 84

showed greater differences between spark-plug failing characteristics of oils than did single-cylinder motors.

7. The L-32-653 technique can probably be used to evaluate the effect of motor design changes on spark-plug fouling with a given fuel-oil combination.

8. Although combustion-chamber and exhaust-port deposits were essentially the same for the two oils, REO-61 showed a marked decrease in ring sticking and piston-skirt varnish.

In the course of the tests, there were 138 plug failures on REO-61 oil and 75 failures on REO-62. Thus, there was a decided difference between the two oils with respect to spark-plug failure tendencies.

The three most common spark-plug failures were gap bridging, core bridging, and gap erosion. (One other type of failure—coated electrodes—was noted by one company.) Of these, gap bridging generally occurred soonest, then core bridging. Gap erosion occurred after the longest average running time.

It was also found that REO-61 oil had a relatively shorter average time for each kind of plug failure than REO-62.

CRC-273 contains 30 pages, includ-

ing 11 tables, 4 figures, and an appendix that outlines the test technique (CRC Designation L-32-653). The report is available from SAE Special Publications Department at $1.50 to members, $3 to nonmembers.

Panel to Study Need For O-Ring Committee

DOES the legion of O-rings being used in today's aircraft have to contain so many ever-so-slightly different members? Are these nuances in design and material really necessary from the standpoint of improved performance in a particular application? One way to find out the answers to these two all-important questions is to set up a group of experts to study the situation . . . and SAE has done just that.

A panel has been formed to look into the desirability of establishing a standing O-ring committee. If a need is indicated, a permanent O-ring committee will be set up as a clearing house for problems involving O-rings.

The aim of such a group would be to consolidate the O-ring programs of individual SAE aeronautic committees and, in doing so, assist the industry in achieving a greater degree of standardization.

Pinpoint Information On Automotive Seating

AUTOMOTIVE seating engineers won't always have to shop around to get basic engineering information on automotive seating. A never-before-available automotive seating manual being prepared by an SAE technical committee should aid the engineer in his search for information.

Thanks to work being done by the SAE Body Engineering Subcommittee on Automotive Seating, trim engineers will have under one cover:

- Definitions of the various automotive seating components.
- Descriptions of the purpose and design requirements of each.
- Descriptions of the various kinds of a particular basic part.
- Descriptions of a number of tests that can be used to determine the acceptability of certain parts.

When completed, this primer on automotive seating will contain sections on seat adjusters, seat frames, seat spring assemblies, pad supports, padding, fastenings, and trim covering.

As of June, 1953, the committee had completed the chapters on padding and pad supports and work was well underway on frames, fastenings, and trim coverings.

New Members Qualified

These applicants qualified for admission to the Society between Dec. 10, 1953 and Jan. 10, 1954. Grades of membership are: (M) Member; (A) Associate; (J) Junior; (SM) Service Member; (FM) Foreign Member.

Atlanta Group

William Rawson Ramy, Sr. (A).

Baltimore Section

Wayne H. Garrett, Jr. (J), Fred John Huston (J).

British Columbia Section

George Edward Clark (A).

Buffalo Section

Pandeli Durbetaki (J), Fred C. Pletzker (J), Samuel Scappettuolo (A).

Canadian Section

Eric Ronald Hilborn (J), Thomas Albert Peake (J).

Central Illinois Section

Tom L. Burcham (J), William C. Pickering, Jr. (J).

Chicago Section

James V. Cantolino (M), Lester Frank Dasse (M), Norman Dean Esau (J), F. Daniel Griswold (J), Irving H. Hallberg (J), James B. Kenny (M), Robert C. Landesman (J), Donald A. Malohn (J), Clayton M. Shepstone (J), J. Roy Wilhelm (J).

Cleveland Section

James M. Cherrie (M), Gail F. Davies (M), Jimmie W. DeMoss (J), Allen E. Dreman (M), Edwin J. Murray (J), Raymond E. Richards (J), Scott A. Rogers, Jr. (M), Ralph Lewis Sabiers, Jr. (J), Thomas Wilson Thoburn, Jr. (J).

Dayton Section

Wayne George Blystone (J), Gail C. Peters (J), Dale A. Randall (J), Eugene Edward Young (J).

Continued on Page 112

New Members Qualified

continued

Detroit Section

Richard Bliss Armstrong (J), John Gibbard Badenhope (A), Robert J. Bayer (J), Frederic W. Brede, Jr. (J), Robert Joseph Browne (J), Keith Graham Burkitt (M), Paul B. Carle (A), Charles S. Chapman, Jr. (J), Ernest DeFusco (J), Donald Droste (J), Walter Kimball Fales (J), Raymond George Falzon (J), Harold W. Foddy, Jr. (J), Raymond J. Haefner (J), John F. Hern (A), Joseph Hyman (J), John W. Ingrody (J), John B. Jackson (M), James H. Lagergren (J), Calvin F. Long (J), Douglas C. Lyall (J), John R. Miller (M), Joseph L. Mitchell (A), Bruce W. Mitton (J), Robert Montgomery (M), Melvin Nadolny (M), Arthur C. Olfs, Jr. (A), Paul G. Racicot (J), Edward J. Rambie (M), George P. Ransom (M), Albert Walter Ratush (J), Paul G. Roberts (J), John Dewey Schultz (J), George William Sheardown (J), Paul J. Smith (M), Charles M. Strachan (M), Carl Donald Taulbee (J), Robert J. Tilley (J), Edward A. Tubbs (A), Warren A. VanWicklin, Jr. (J), Harold Von Bergen (M), Raymond Walker (M), Edwin Rudolf Wanhala (M), Michael Waypa, Jr. (J), Francis J. Weber (M).

Hawaii Section

Farnham J. Johnson (A).

Indiana Section

L. L. Clark (M), Joseph J. Foyst (J), Wallace E. Graham (J), Harold Peter Horwitz (J), Richard E. Young (M).

Kansas City Section

Robert E. Adel (J).

Metropolitan Section

K. C. Bernes (A), Edward S. Clark (M), Herbert S. Coleman (M), Wesley T. Dorsheimer (A), Theodore C. DuMond (A), Roger T. Ellis (J), Frederick P. Glazier (M), Harry Judson Holcomb (J), Howard C. Reenstra (J), Harlan M. Smith (M), Stanley Roy Spector (J), Edgar Kenneth Stewart (J).

Mid-Michigan Section

Robert J. Breeden (M), Thomas Pavlovich (J), Dulaney D. Smith (A).

Milwaukee Section

B. L. Loungren (M), Warren D. Nutten (J).

Mohawk-Hudson Group

Patrick J. Burno (M), Joseph J. Milich (J).

New Members Qualified

continued

Montreal Section

William Marshall Seath (J), Murray E. Wight (M).

New England Section

Joseph Henry Valentine (J).

Northern California Section

Val Gates (M), Wm. C. Keil (J), William H. Moranda (J), William James Wood (A).

Northwest Section

Mark Edwin Kirchner (M), Otto E. Kirchner, Jr. (M).

Philadelphia Section

Harold N. Meyer (M), Robert D. Miller (M), Charles Emerson Norton (M).

Pittsburgh Section

Michael J. Amoroso (J), Robert C. Barker (M), E. R. Gibbs (J), Edward A. Jamison (M), Charles Gilbert Slater (J), Frank J. Stodolsky (J), John Bartlett White (J).

San Diego Section

Wallie Paul Gray (M), A. F. Kitchin (M), Russell H. Thomas (J).

Southern California Section

Richard J. Corbett (J), Robert A. Lohmann (J), Anthony William Magula (J), John J. Petraits (J), Charles M. Reid (J), George A. Starbird (M), Don A. Young (M).

Southern New England Section

George C. Peterson (M), Edward F. Wilk (J).

Spokane-Intermountain Section

Louis Glist (M), W. E. Kellogg (A).

Syracuse Section

Walton Bertrand Baldwin (J), Donald S. McDowell (J), Samuel R. Murray (J), William A. Uline (M).

Texas Section

Henry A. Clutz (J), William Raymond Cook (A), Henry J. Korp (M), James Barry Temple (J), James Edward Wier (J).

Twin City Section

Charles H. Whitmore (M).

Washington Section

Conrad J. Bowman (M).

Western Michigan Section

Eric C. Nulsen (J), Allan E. Swartz (J).

Continued on Page 114

New Members Qualified

continued

Wichita Section

Howard Walter Hines (J).

Williamsport Group

Howard B. Hile (J).

Outside Section Territory

John Y. H. Ahn (A), Leonard E. Christoferson (J), Charles George Fletcher (J), John H. Jessen (J), Arlan E. Kelley (A), M. L. Nelson (M).

Foreign

Fazal Ahmad Chaudhry (A), Pakistan; Charles Kearns Edwards (M), England; Paul Victor Heron (M), England; Sun Li-Teh (M), Formosa; Georg Muselius (M), Finland; Ing. Prof. Angelo Patrassi (M), Italy.

Applications Received

The applications for membership received between Dec. 10, 1953 and Jan. 10, 1954 are listed below.

Baltimore Section

Thomas R. Aderton, Dean Bedford, Jr., George W. Wood, Jr.

British Columbia Section

J. D. Finnie.

Buffalo Section

John A. Geiger, Joseph R. O'Neil.

Canadian Section

George D. Atkinson, Edgar Barker, George H. Bates, Kenneth V. Bilton, John Bonfield, Stanley Edge, A. N. Giasson, G. R. Graves, R. M. Healey, Jack F. Hernick, Barnard B. Lewis, Frederick James Skinner, F. G. Stohge, Stanley Wallace.

Central Illinois Section

Theodore Harry Fones, Charles Edward Grawey, Homer Gurtler, Gerald R. McDonald.

Chicago Section

Stanley W. Anderson, Stanley M. Humphrey, Joseph B. Jollief.

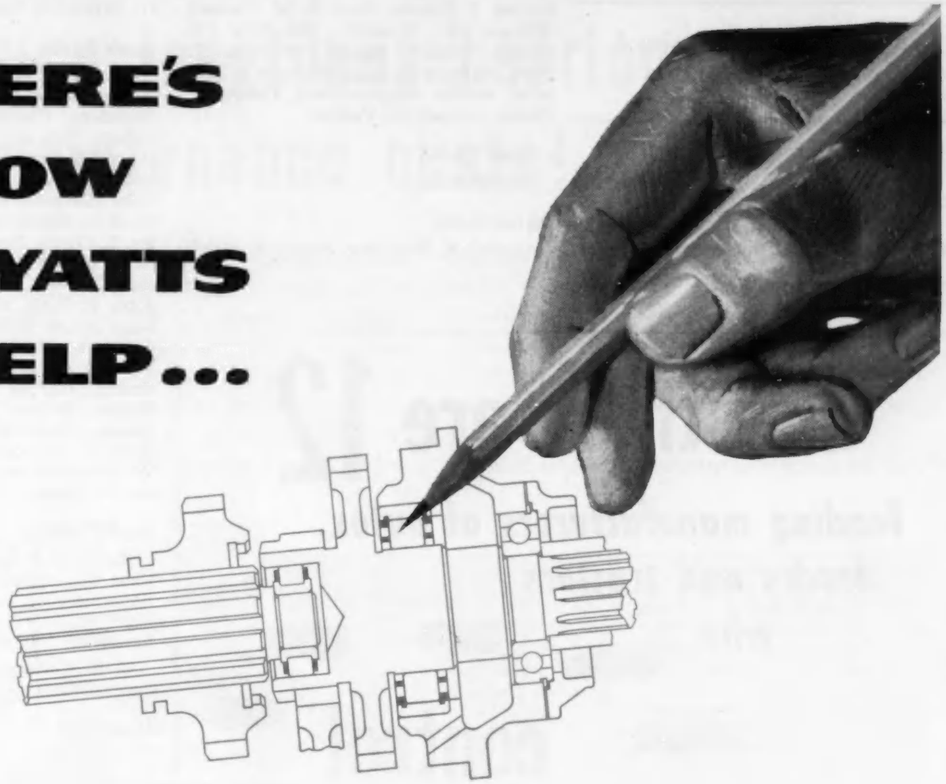
Cincinnati Section

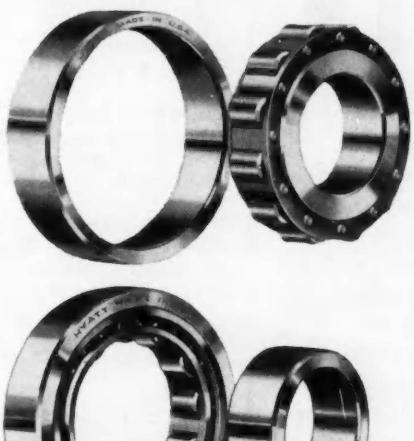
Carl E. Clutter, William F. Simpson.

Continued on Page 116

when LIMITED SPACE is a design factor

HERE'S HOW HYATTS HELP...





Sometimes a fraction of an inch is the difference between a simple design modification and costly re-tooling. And the engineer who is thoroughly familiar with Hyatt Roller Bearings will know a lot about how to save those fractions. He'll know, for example, that to gain greater shaft rigidity with the same size housing, he need only check his Hyatt catalog for a separable inner race type of bearing. This type—available in a wide range of sizes—may be applied with the rollers operating directly upon the surface of a suitably hardened and ground shaft. Thus, a larger-diameter shaft may be used without sacrificing bearing capacity, or a larger-size bearing may be used without changing the size of the shaft. For a copy of Hyatt's latest catalog, No. 150, write to Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

STRAIGHT BARREL TAPER

Applications Received

continued

Cleveland Section

Don D. Barner, Jacob K. Brixius, E. L. Carlotta, C. Robert Derhammer, Lucien J. Dreyer, Paul B. M. Farwell, William P. Frissell, Woodrow W. Heigle, Georg Mladsi, William K. Park, Edward G. Rapp, Donald J. Rosselle, Walter Schuttenberg, George E. Slater, Donald H. Voelker.

Colorado Group

Bruce Hanna.

Dayton Section

George K. Manning, Joseph A. Mileti, Jr., Wilbur J. Oakley, Eldone H. Truex.

Detroit Section

Harold L. Anderson, James B. DeWolfe, Sven Backlund, Edo Anthony Conedera, Claude F. Cowley, Donald Russell Edgar, Edward L. Francis, Martin B. Gresehover, Carl Johan Gustafsson, James Leslie Hagener, Matthew Thomas Hayes, Paul A. Heber, Clare L. Hitchcock, Frederick E. Hoadley, L. Glenn Hogsten, Earl P. Holiday, Roy Charles Holmstrom, John L. Jackson, Dave R. Jones, Jr., Cleo H. Key, John K. Kolb, Frank B. Lewandowski, Kent Roger Manning, Joseph Misany, James Hazlitt Munger, Gerhard Peitsch, W. D. Sexauer, Gregory Paul Shaltz, Harold M. Shattuck, Jay G. Smith, Richard Strickland, Emil V. Szlaga, Stephen L. Thorne, Sune E. Timour, Theodore G. Vickers, Charles W. Watrous, Eugene M. Welch, Richard Williams, Frank L. Wetherholt.

Indiana Section

James B. Dillon, Richard R. Hunter, Paul E. Martin, Harold B. Tappen, Alexander M. Zrolka.

Kansas City Section

S. K. Cannon, Darell D. DonCarlos, James Fagg.

Metropolitan Section

Irvin Ritter Clark, Lawrence Cranston, Donald I. Harrison, A. Freeman Hess, J. L. Teach, Halsted R. Warrick, Leo A. Weiss, Howard L. Yowell.

Mid-Continent Section

John J. Hinch.

Mid-Michigan Section

Irwin Lee Collier, Karl F. Maier, John J. Schramek, William Finis Thornburgh.

Milwaukee Section

James Prescott Harmon, John S. Skowronski, Eugene F. Tietenthaler, Benton T. Wiechers.

Mohawk-Hudson Group

Hansjoerg Stern.

Montreal Section

James Gardiner Dick, John Peter Fullam, Michael John Scovell, Jean-Paul Villeneuve.

Northern California Section

Keith M. Baker, Robert W. Burchell, Glenn D. Seaman.

Northwest Section

Jackson A. Blackler, Charles A. Wilson.

Philadelphia Section

John Alden Glass, August Herman, Leo W. Manley, George C. Wright.

Continued on Page 118

Here's how BOWER Spher-o-honed design lengthens bearing life... cuts maintenance costs!

The Bower tapered roller bearing design features shown on this page are vitally important to every bearing user. For they illustrate the high quality, precision workmanship and close attention to engineering detail that go into *every* Bower bearing. Even more important, these Bower design features will give you significant bearing advantages such as reduced wear, longer bearing life and lower maintenance requirements. They've been thoroughly *proved* by extensive use in virtually every type of bearing application. If your product uses bearings—whatever it may be—specify Bower now. Or better yet, call in a Bower engineer while your product is still in the blueprint stage.

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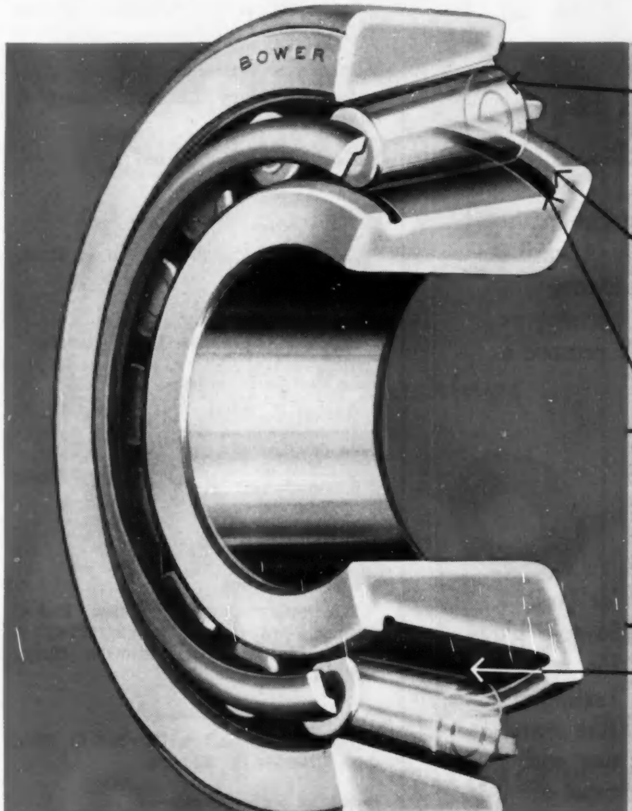

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Applications Received

continued

Pittsburgh Section

Walter Robert Kazor.

St. Louis Section

Glenn E. Gaines, William A. Scheublein, Jr.

San Diego Section

Hugo F. Mohrlock, John Norse, Ronald Stanley Oberst, James A. Symons.

Southern California Section

Harold H. Block, Frank Wesley Cooper, James B. Cooper, David D. Dean, Lewis H. Garrett, Joseph B. Hunt, Oliver Hansen Jacobson, L. A. Lesovsky, G. S. Massa, R. M. Myers, Arthur E. Pearson, Jr., Floyd Douglas Roberts, Ralph Robert Roesky, Wilfred F. Talbot, Ivan Viets.

Southern New England Section

Joseph Henry Lareau, Robert C. Olsen.

Spokane-Intermountain Section

Orville Blaze Isaacs.

Syracuse Section

Erving W. Parry, William B. Pashkow.

Texas Section

Edward A. Garner, L. E. Ullrich.

Texas Gulf Coast Section

Austin P. Boyd, E. L. Cranford.

Twin City Section

Howard W. Carlsen, Melvin F. Diels.

Virginia Section

Harold A. Weisman, Jr.

Washington Section

Mieczyslaw Gregory Bekker, Hal C. Farrell, Francis R. Kadie, Fred A. Rohrs, John Cyril Knowles Shipp, Buford A. Stone.

Western Michigan Section

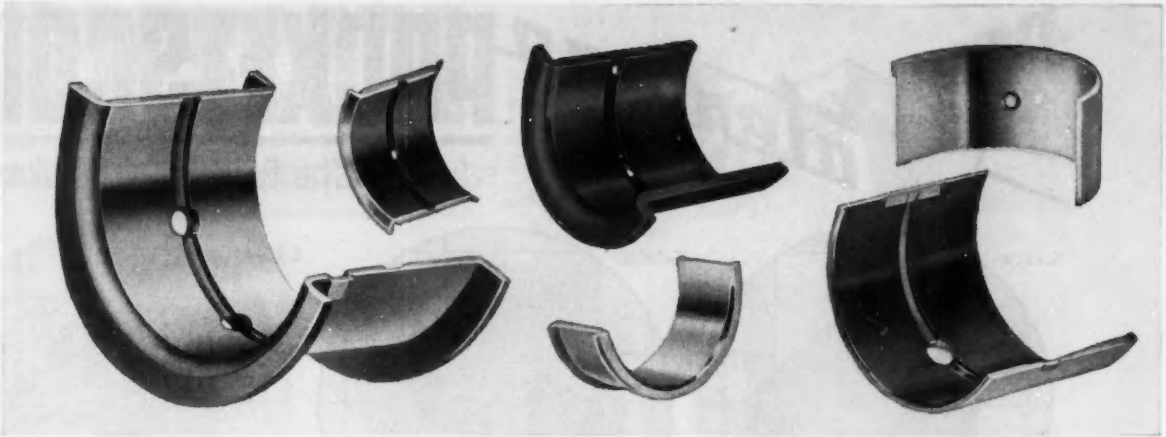
Walter C. Chaffee, Edward O. Hobday, Charles R. Klooster.

Outside of Section Territory

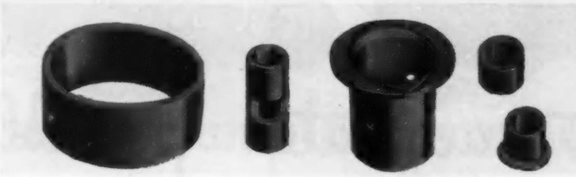
Karl Clifton Anderson, Clarence J. Carlson, John D. Gill, Lt. Julius Grigore, Jr., Gamble E. Huffaker, James W. Humphrey, R. G. Wendt.

Foreign

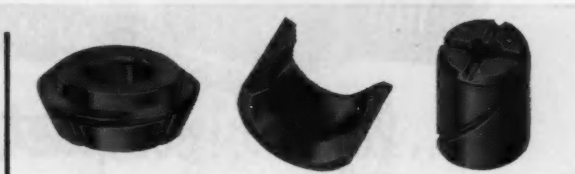
Clifford Catterall, England; Albert Leslie Gatiss, England; Louis Michel Hedde, France; Rene Adolphe Laloux, Belgium; William Garland Long, Crown Colony; Ivor Harold Smart, England.



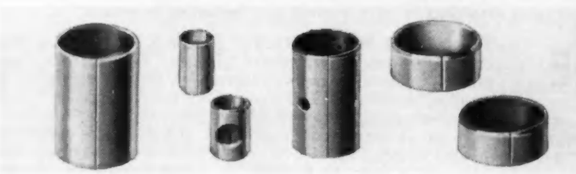
Sleeve bearings in a wide variety of designs and sizes



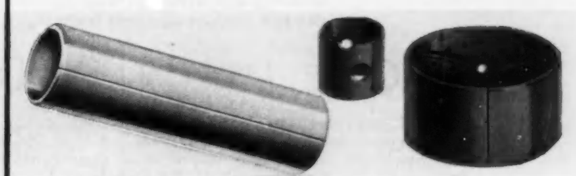
Cast bronze bushings



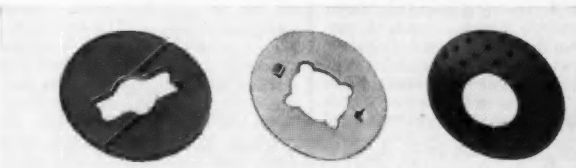
Precision bronze parts



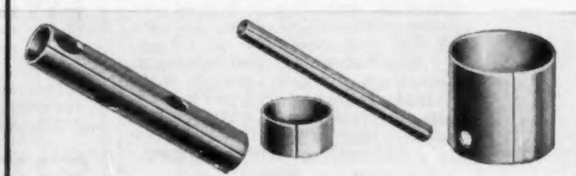
Bi-metal split bushings



Rolled split bushings



Washers



Spacer tubes

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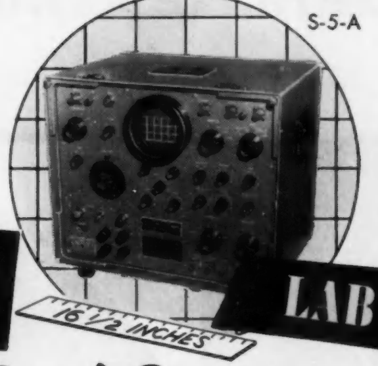
Since **FEDERAL-MOGUL** 1889

PULSESCOPE by Waterman

The Oscilloscope that Portrays the Pulse



Classic Examples of Precision Engineering...

The PULSESCOPES are cathode ray tube oscilloscopes that portray the attributes of the pulse: shape, amplitude, duration and time displacement. All PULSESCOPES have internally generated markers with the basic difference that in the SAR PULSESCOPE the markers initiate the sweep while in the others the sweep starts the markers.

BROAD

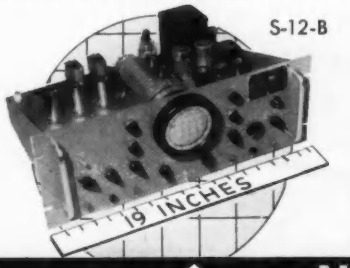
The S-6-A BROAD BAND Scope is a PULSESCOPE in performance, POCKETSCOPE in size. The instrument measures DC as well as AC signals. Unique DC calibration methods permit rapid measurements of either positive or negative, AC or DC signals. Vertical amplifier sensitivity of 0.2v rms/inch, and response to 5 mc within 3DB . . . pulse rise time of 0.1 μs . . . internal markers from 1 to 1000 μs . . . repetitive or trigger sweep from 5 cycles to 500 KC with 5X sweep expansion . . . sweep, marker and DC calibrating voltage available externally. Size 8½ x 6¾ x 13¾ in. Weight 22 lbs. Operates from 50 to 400 cycles at 115 volts AC.

LAB

The S-5-A LAB PULSESCOPE is a JANized (Gov't Model No. OS-26) portable, AC, wide band-pass, laboratory oscilloscope ideal for pulse as well as general purpose measurements. Internal delay of 0.55 μs permits observation of pulse leading edge. Includes precision amplitude calibration, 10X sweep expansion, internal trace intensity time markers, internal trigger generators and many other features. Video amplifier 0.1v p to p/inch . . . pulse rise time of .035 μs or response to 11 mc. 1.25 to 125,000 μs triggered or repetitive sweep . . . internally generated markers from 0.2 to 500 μs . . . trigger generator from 50 to 5000 pps. for internal and external triggering. Operates from 50 to 400 cycles at 115 volts AC.

SAR

The S-4-C SAR PULSESCOPE is a JANized (Gov't Model No. OS-4) portable instrument (31.5 lbs.) for precision pulse measurements for radar, TV and all electronic measurements. Portrays all attributes of the pulse . . . internal crystal controlled markers of 10 and 50 μs available for self-calibration . . . in R operation a small segment of the A sweep is expandable for detailed observation with a direct-reading calibrated dial accurate to 0.1%. Video amplifier band-pass up to 11 mc . . . optional video delay 0.55 μs . . . pulse rise and fall time better than 0.07 μs . . . R pedestal (sweep) 2.4 to 24 μs . . . video sensitivity of 0.5v. p to p/inch. Easily convertible from μs to yards. Operates from 50 to 400 cycles at 115 volts AC.



RAKSCOPE

Because the panel is only 7" high and fits any standard rack, the S-12-B RAKSCOPE admirably fills the need for a small oscilloscope of wide versatility. With all the features of the S-11-A POCKETSCOPE, the RAKSCOPE is JANized (Gov't Model No. OS-11), and has many additional advantages; the sweep, from 5 cycles to 50 KC, is either repetitive or triggered . . . vertical and horizontal amplifiers are 50 mv rms/inch with band-pass from 0 to 200 KC . . . special phasing circuitry for frequency comparison.

WATERMAN PRODUCTS CO., INC.

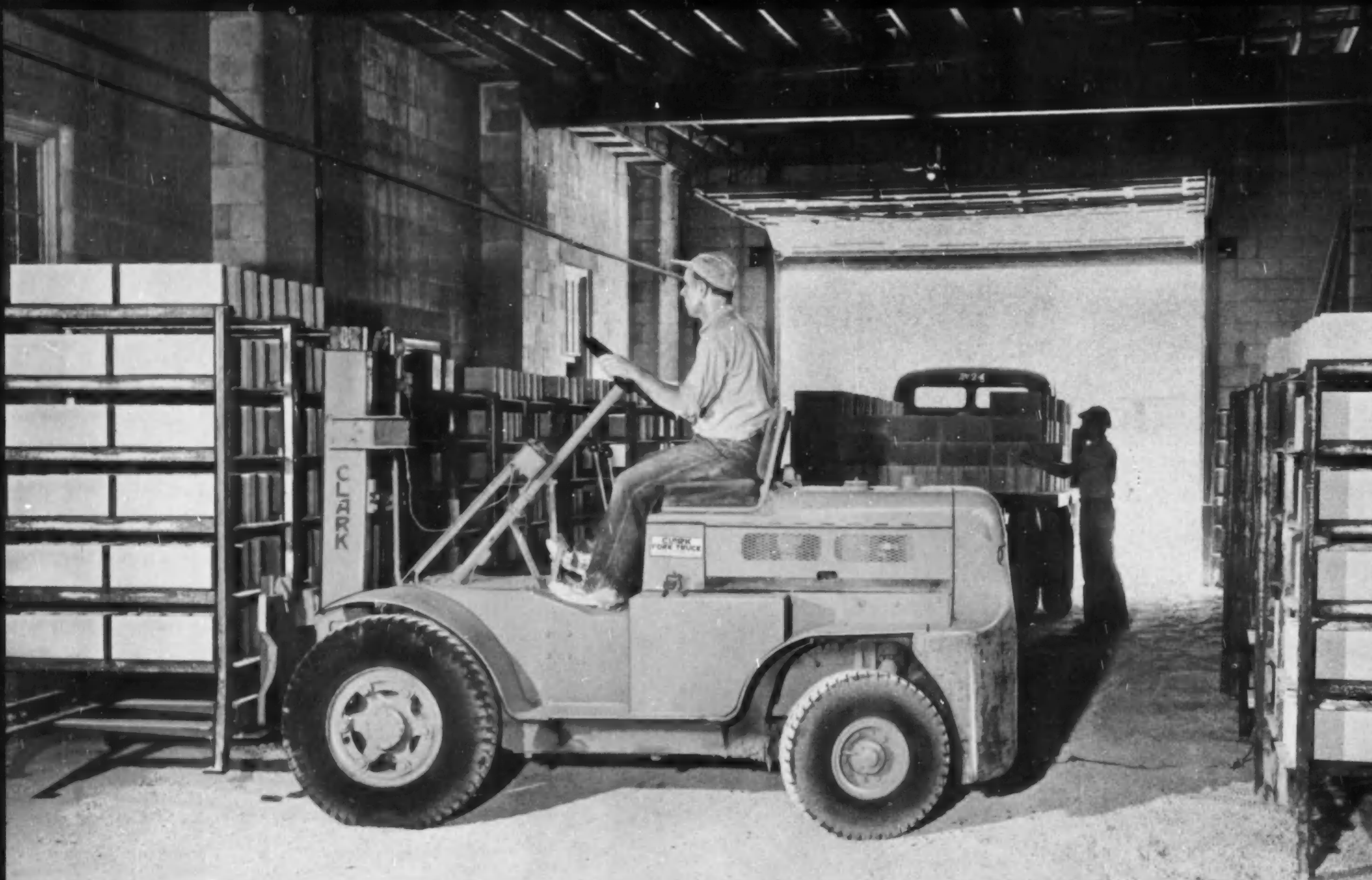
WATERMAN PRODUCTS

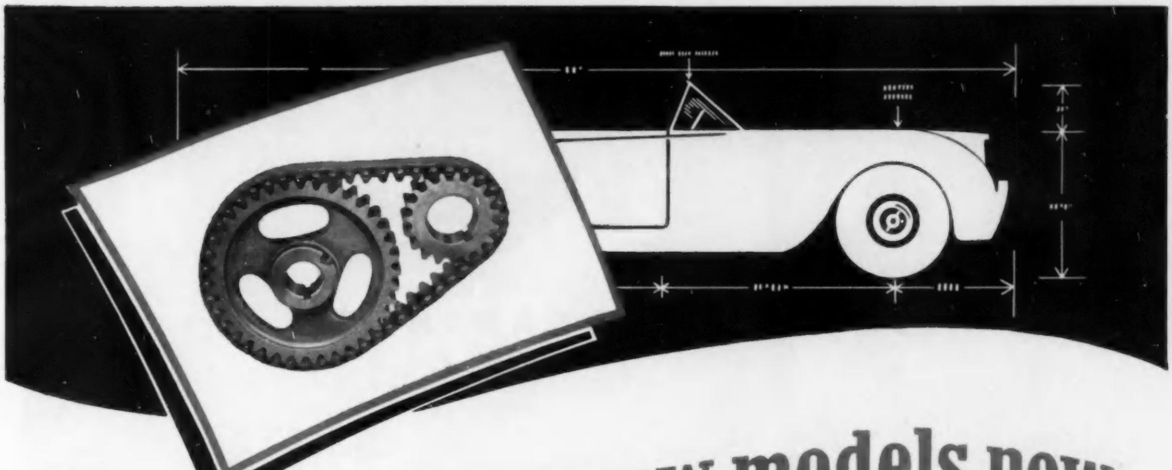
PHILADELPHIA 25, PENNA., U.S.A.

CABLE ADDRESS, POKETSCOPE, PHILA.

Manufacturers of POCKETSCOPES® · RAKSCOPES® · PULSESCOPES® and RAYONIC® TUBES

For Long Life it's
CLARK
AXLES
Front and Rear
RUGGED
DURABLE
SIMPLE
ECONOMICAL
Do you use
PRECISION
GEARS
?
CLARK
produces them
...MOST TYPES,
MOST SIZES
When vehicle specifications include "Clark Axles"—
truck, bus or heavy road equipment—it's proof
that the builder aimed at producing a quality unit.
Taking the shocks, carrying the load, minimizing wear!
It's "good business" to do business with Clark
CLARK
EQUIPMENT
CLARK EQUIPMENT COMPANY • BUCHANAN • Battle Creek, Benton Harbor and Jackson, Michigan


CLARK



More and more new models now TIME with CHAIN

and LINK-BELT Timing Chain gives you

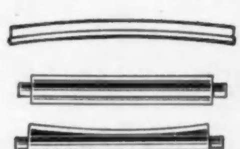
- **Automatic joint snugness**
- **Smoother operation**
- **Longer life**

FOR greater design flexibility plus superior performance, leading automotive manufacturers are swinging to timing chain. Let our engineers show you how this outstanding chain can fit into your latest engine. Engineering and specification details are available in Book 2065.

LINK-BELT

TIMING CHAIN and SPROCKETS

Segmental bushings provide automatic joint snugness



Segmental bushings are made with slight bow.

After initial assembly in chain, bushings are straight.

Bow in bushing acts to keep a snug joint.

LINK-BELT COMPANY: 220 South Belmont Ave., Indianapolis 6, Ind. Offices in principal cities. 13,334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bright spot
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JOHNSON BEARINGS
Labor costs, overhead and materials continue to rise. Yet . . . here is one item on which you can save money . . . Johnson Sleeve Bearings. They are low in first cost, economical in installation, and give long, satisfactory performance. Perhaps you are using more bearing than you need. Investigate Johnson Bearings. They are produced in industry's widest range of bearing metals and types: aluminum on steel, bronze on steel, babbitt on steel or bronze, powder metallurgy, cast bronze, cast aluminum alloy, sheet bronze and graphite inserts. Design or redesign to utilize the economies of Johnson Sleeve Bearings. Free engineering consultation is yours for the asking. Write.
JOHNSON BRONZE CO.
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JOHNSON JB BEARINGS
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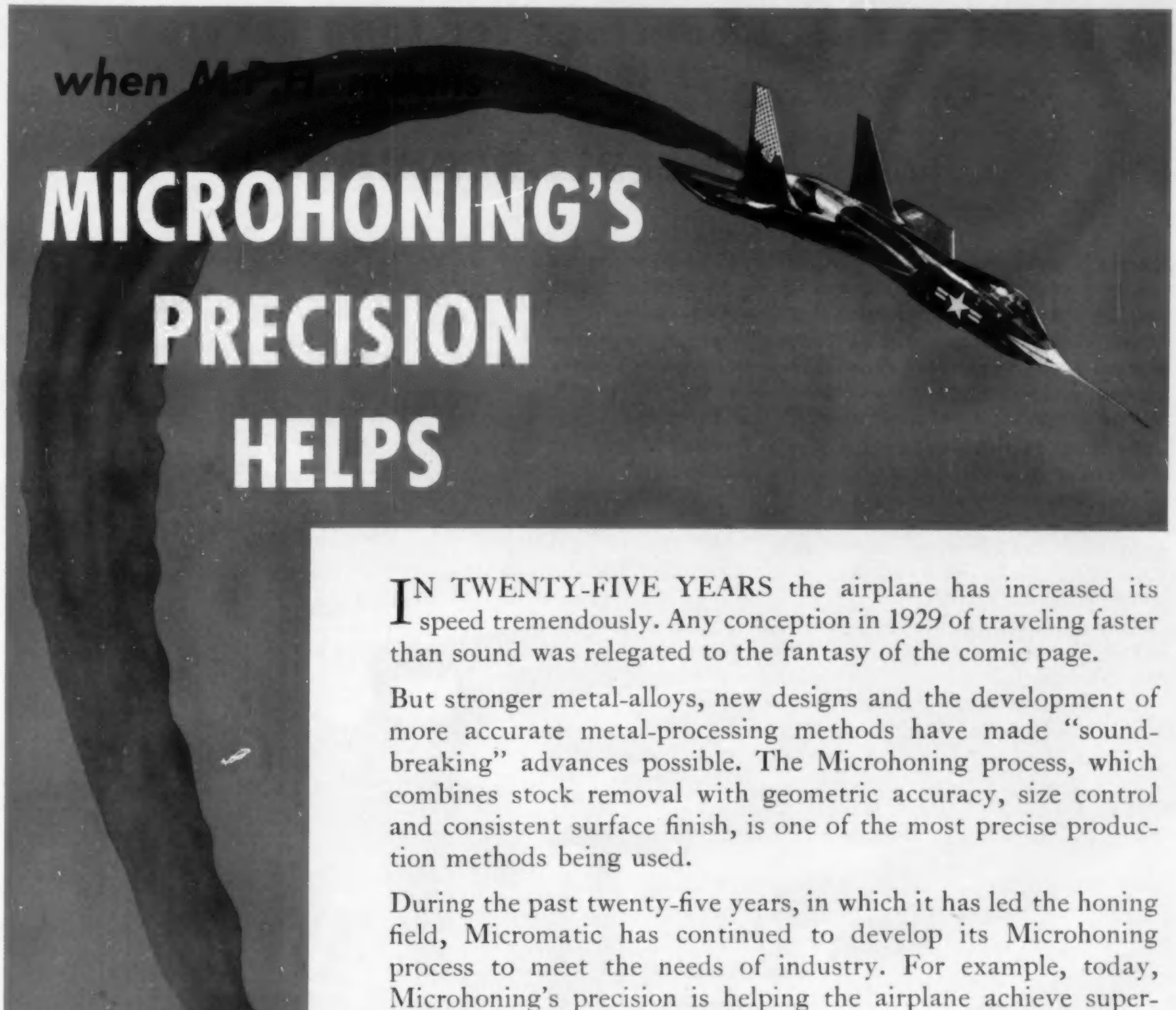
when
MICROHONING'S PRECISION HELPS
IN TWENTY-FIVE YEARS the airplane has increased its speed tremendously. Any conception in 1929 of traveling faster than sound was relegated to the fantasy of the comic page.
But stronger metal-alloys, new designs and the development of more accurate metal-processing methods have made "sound-breaking" advances possible. The Microhoning process, which combines stock removal with geometric accuracy, size control and consistent surface finish, is one of the most precise production methods being used.
During the past twenty-five years, in which it has led the honing field, Micromatic has continued to develop its Microhoning process to meet the needs of industry. For example, today, Microhoning's precision is helping the airplane achieve supersonic speeds.
Through such aids as Microhoning, the comic page fantasy has been moved to the front page of reality.
MICROHONING = STOCK REMOVAL + GEOMETRY + SIZE CONTROL + SURFACE FINISH
1929 · 1954
PRECISION PRODUCTION THROUGH MICROHONING
MICRO MATIC
TRADE MARK
25TH YEAR OF DEVELOPMENT
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MICROMATIC HONE CORP. 1535 Grande Vista Ave. Los Angeles 23, California
MICROMATIC HONE LTD. 330 Grand River Ave. Brantford, Ont., Canada
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REPRESENTATIVES: Allied Northwest Machine Tool Corp., 103 S.W Front Avenue, Portland 4, Oregon. • Tidewater Supply Co., Charlotte 4, North Carolina.
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Hydraulic controls • injection equipment

Need compact bearings for long service?

here's how leading makers of small gasoline engines get them with **NEEDLE BEARINGS**

America's best known manufacturers of small gasoline engines specify Torrington Needle Bearings because of their compactness, high capacity and long maintenance-free operation.

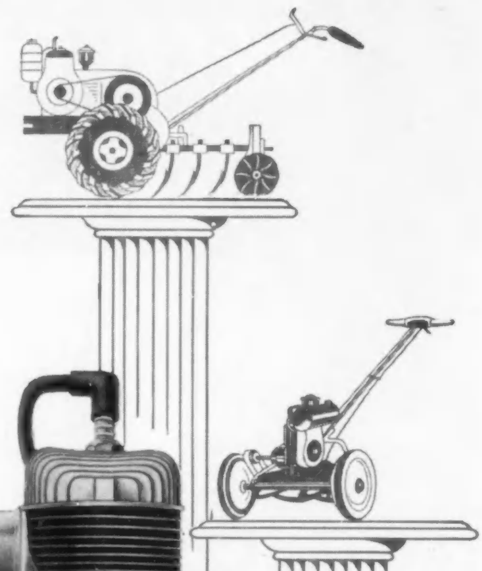
Needle Bearings have been *performance-proved* in every type of small two-cycle and four-cycle engine such as those on power mowers, generators, chain saws, materials handling equipment, pumps, compressors and many other types of equipment.

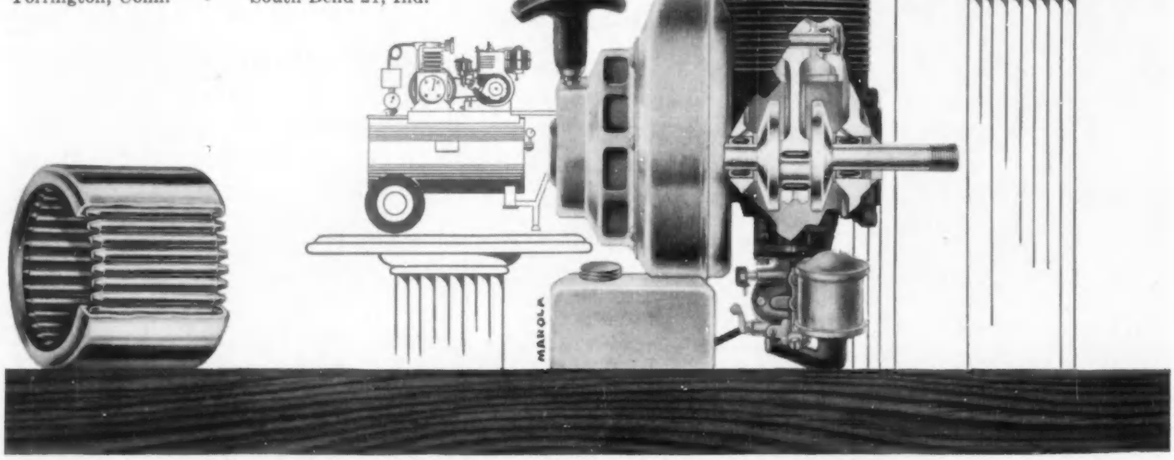
As main bearings on crankshafts, on connecting rods at crankpin and wristpin ends, on reduction units, governing mechanisms, crankshaft counter-balances and camshafts, Needle Bearings, compact in size themselves, contribute toward keeping engine size and resulting weight down. Simultaneously, their ability to retain lubricants for long periods boosts power output and prolongs engine life.

Torrington Needle Bearings have become "standard equipment" throughout industry since their introduction nearly twenty years ago. Wherever high capacity is needed in small space, Needle Bearings can offer superior performance.

The Needle Bearing may be the solution to your anti-friction problems. Why not let our engineers help you find out?

THE TORRINGTON COMPANY
Torrington, Conn. • South Bend 21, Ind.



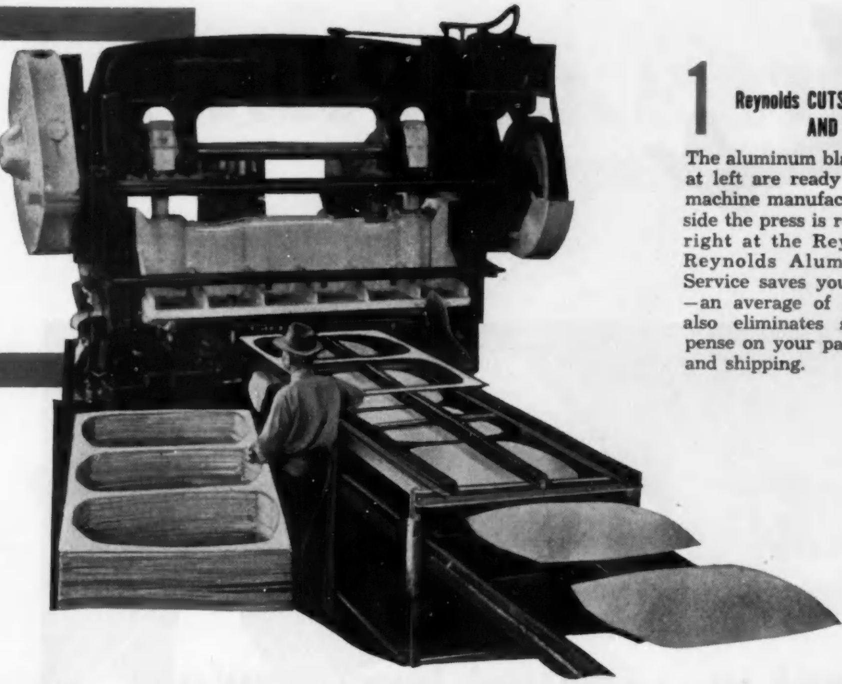


TORRINGTON *NEEDLE* BEARINGS

Needle • Spherical Roller • Tapered Roller • Cylindrical Roller • Ball • Needle Rollers

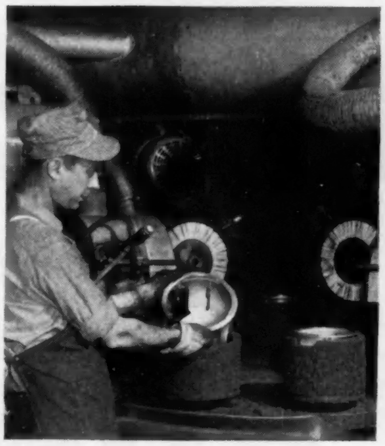
Trade-marks of leading manufacturers of small gasoline engines who use Needle Bearings.


CWC
Since 1908



1 Reynolds CUTS YOUR SCRAP LOSS AND SCRAP HANDLING COSTS

The aluminum blanks on the conveyor at left are ready to go to a washing machine manufacturer. The scrap beside the press is remelted immediately right at the Reynolds plant. Thus Reynolds Aluminum Fabricating Service saves you—the manufacturer—an average of 30% scrap loss and also eliminates scrap handling expense on your part in sorting, storing and shipping.



5 Reynolds CUTS YOUR MATERIAL HANDLING COSTS

The aluminum pallets above will reduce material handling costs in many plants . . . and the manufacturer of these pallets is also reducing *his* material handling costs by getting *pounds of parts*, not pounds of metal, from Reynolds Aluminum Fabricating Service. Reynolds also takes the problems of scheduling, material supply, labor and machine availability off his—and your—hands!

6 Reynolds RELEASES YOUR WORKING CAPITAL

When you use Reynolds Aluminum Fabricating Service you receive 100% of your aluminum in finished parts. And, as these parts are generally assembled into finished products before invoices come due, no investment is tied up in raw metal. These quality parts, like the shells of the aluminum cookers being buffed above, are available in a wide choice of finishes including color-anodized.

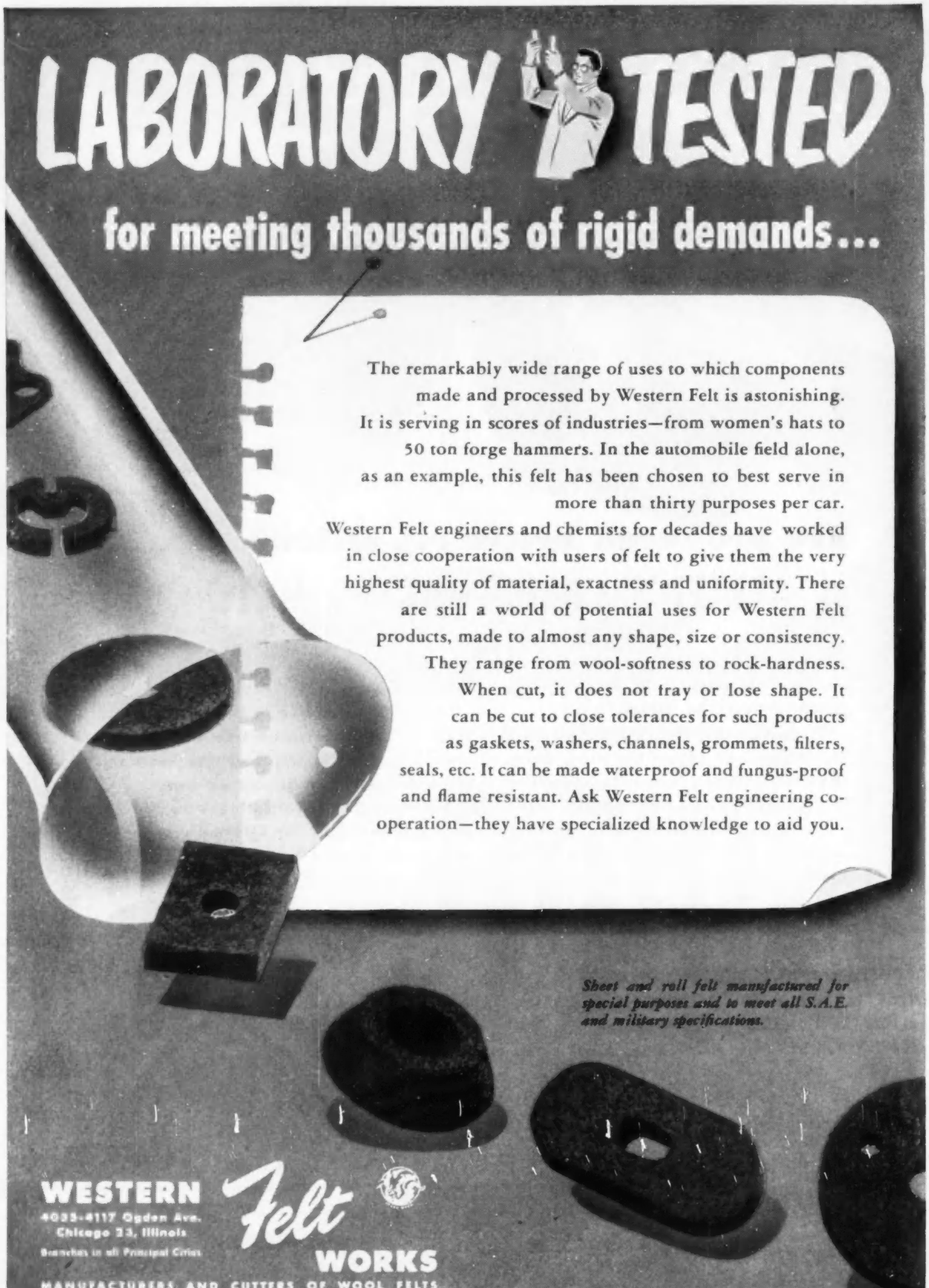
7 Reynolds ELIMINATES YOUR REJECT COSTS

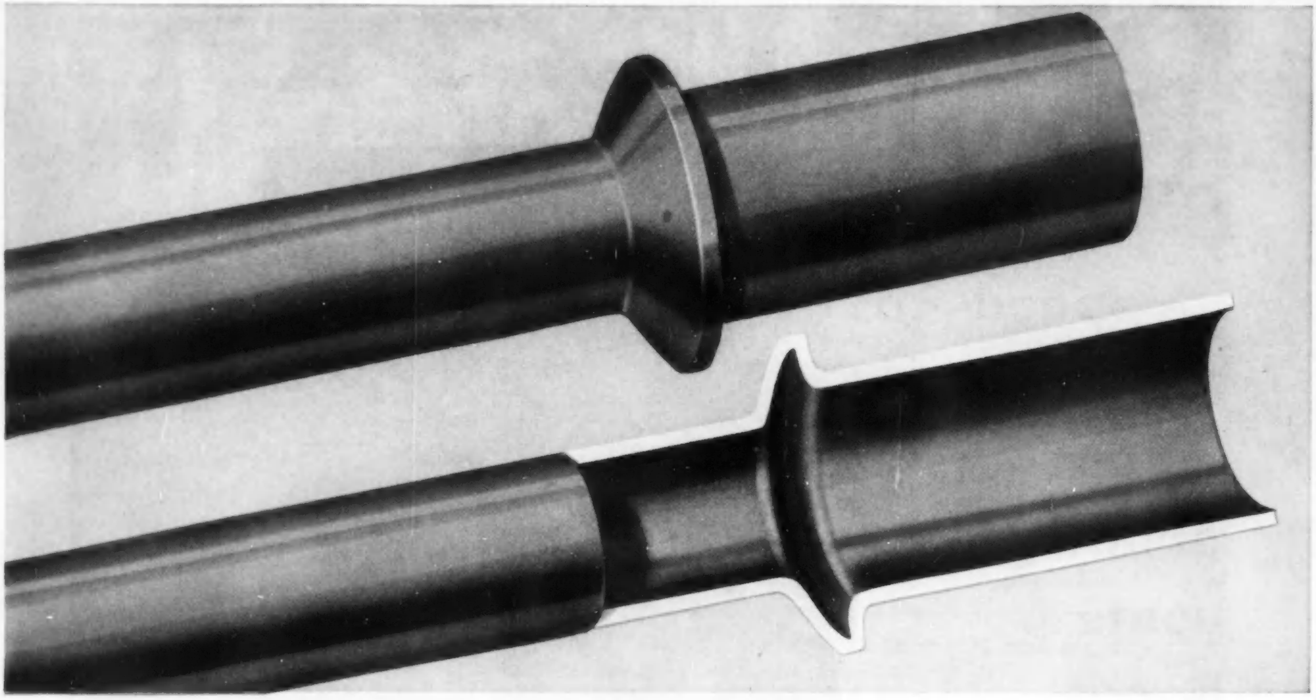
Reynolds Aluminum Fabricating Service does away with your machine and labor production losses and inspection expense in rejects, because you pay only for finished, inspected parts. The conveyor line above, where refrigerator door trays are carefully inspected before packing and shipping, is just one of the many examples of Reynolds quality control from mine to finished product.

See "Mister Peepers" Sundays on NBC-TV. Consult local listing for time and station.

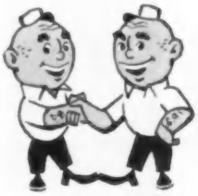
FABRICATING SERVICE

SHAPING • TUBE BENDING • WELDING • BRAZING • FINISHING


LABORATORY TESTED
for meeting thousands of rigid demands...
The remarkably wide range of uses to which components made and processed by Western Felt is astonishing. It is serving in scores of industries—from women's hats to 50 ton forge hammers. In the automobile field alone, as an example, this felt has been chosen to best serve in more than thirty purposes per car. Western Felt engineers and chemists for decades have worked in close cooperation with users of felt to give them the very highest quality of material, exactness and uniformity. There are still a world of potential uses for Western Felt products, made to almost any shape, size or consistency. They range from wool-softness to rock-hardness. When cut, it does not fray or lose shape. It can be cut to close tolerances for such products as gaskets, washers, channels, grommets, filters, seals, etc. It can be made waterproof and fungus-proof and flame resistant. Ask Western Felt engineering co-operation—they have specialized knowledge to aid you.
Sheet and roll felt manufactured for special purposes and to meet all S.A.E. and military specifications.
WESTERN Felt WORKS
4035-4117 Ogden Ave.
Chicago 23, Illinois
Branches in all Principal Cities
MANUFACTURERS AND CUTTERS OF WOOL FELTS



1 Here's a problem part clearly showing the results you get when Bundy engineers are on your team. The part, for the servomechanism on a braking system, called for an end expansion from 3/8" to 1/2"—an extreme expansion even for Bundyweld. Complicating matters, an upset was required on the expansion. Low-cost, accurate result is a tribute both to the fabrication beating Bundyweld will take and to the talents of Bundy engineers. It is also a sure indication of the successful results you can expect from Bundy on your problem parts—and your easy-to-make ones.



Look at all you buy in Bundyweld Tubing

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

← **NOTE** the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

Bundy Tubing Distributors and Representatives: ***Bridgeport, Conn.:*** Korhumel Steel & Aluminum Co., 117 E. Washington St. • ***Cambridge 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. • ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Los Angeles 58, Calif.:*** Tubesales, 5400 Alcoa Ave. • ***Philadelphia 3, Penn.:*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave., South • ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., East.
Bundyweld nickel and Monel tubing are sold by distributors of nickel and nickel alloys in principal cities.

COLOR is your most eloquent salesman

COLOR is a salesman that speaks for itself . . . in a language that everyone understands . . . the subtle language of the emotions. In a thousand variations, color plays upon the senses to arouse the imagination, to intensify interest, and to stimulate the buyer to act. It is powerful in its ability to attract and hold attention; powerful in its ability to enhance the value of a product . . . whether it be in the flowing lines of an automotive design, or the streamlined styling of a locomotive.

Make the most of color and you will make the most of sales. In this direction, you are cordially invited to call upon the Creative Color Styling Section of the Rinshed-Mason Company for help with your color styling program.

R-M automotive and industrial finishes are known for color richness, exceptional *workability* and durability in service.

E. G. Wettlaufer

The automotive design shown above is the work of the Wettlaufer Engineering Corporation of Detroit, Michigan, prominent automotive and industrial designers and engineers. Incorporated in this design is a pancake type engine, full 360° vision, low center of gravity, hydraulic trunk and hood lift, electrically controlled door locks, power steering and other features.

RINSHED-MASON COMPANY

DETROIT 10, MICHIGAN

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R-M

Manufacturers of fine lacquers, enamels and undercoats for automobiles, trucks, farm equipment, railroad equipment, appliances and numerous other products of industry.


right from every angle . . .
RIGHT ANGLE
Roller
Ends
RIGHT ANGLE
Bearing
Surfaces
RIGHT ANGLE
Separator
Slots
Longer operating life? Right!
Less maintenance? Right again!
Heavy-duty equipment "rolls right" with Rollways because . . .
. . . solid cylindrical rollers provide the long line-contact required by heavy loads.
. . . precisely made ends, bearing surfaces and retainer slots restrict end-rub, skew and side-shock.
. . . special alloys in the races resist spalling and brinelling.
It all adds up to a bearing that rolls longer, takes less maintenance, prolongs the life of your equipment.
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• Let our engineers help you select the Rollway bearing that's exactly right for your application. No charge —no obligation.
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Complete Line of Radial and Thrust Cylindrical Roller Bearings

Engineered
HEAVY DUTY
Performance
DUALOY will improve the economy and efficiency of heavy duty engines.
We solicit your invitations to assist in solving design and operation problems.
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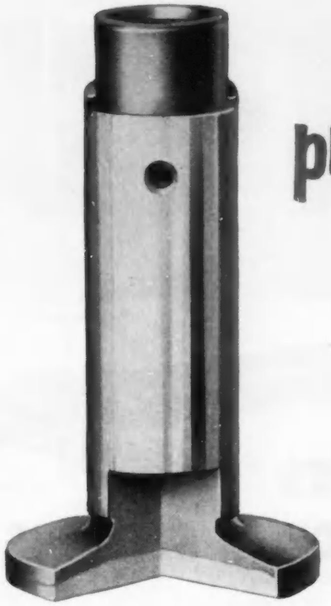
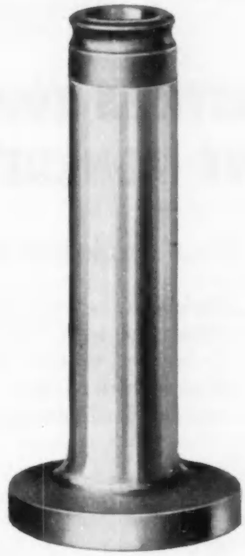
Better Pistons Since 1922
Enlarged Cut-away of Ni-resist Ring Groove
*Trademark Registered.
*The United Engine & Machine Company (manufacturers of Silv-o-Lite pistons) are licensed by Al-fin, a subsidiary of Fairchild Engine & Airplane Corporation under Bi-metallic piston patents 2396730, 2455457 and 2550879 in the manufacture of molecular bonded pistons.
DUALOY*
THE 1st BI-METALLIC MOLECULAR BONDED PISTON
UNITED ENGINE AND MACHINE COMPANY
310 PREDA STREET · SAN LEANDRO, CALIFORNIA

for modern high-speed engines

Eaton Tappets



stand up under prolonged heavy-duty conditions



The higher tappet loads in modern engines require extremely hard tappet faces and light weight bodies to insure proper functioning of the valve train. Eaton tappets combine these important advantages. A unique puddling method, perfected by Eaton over a period of years, produces exceedingly hard white iron tappet faces on steel bodies, providing high load-carrying capacity of face combined with desired lightness of the steel body. With this combination of superior strength, light weight, and wear-resistant face, these tappets can be depended upon to give long, trouble-free operation in heavy-duty service.

EATON MANUFACTURING COMPANY

General Offices: CLEVELAND, OHIO

SAGINAW DIVISION: 9771 FRENCH ROAD • DETROIT 13, MICHIGAN

PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

SCHWITZER-CUMMINS

New Turbo Charger Shows How

This new lightweight, low cost exhaust driven turbo charger, for Diesel engines in the 100-200 hp range, is produced by Schwitzer-Cummins Co., Indianapolis, Ind.

Ni-Resist Defeats Corrosion... Erosion... Heat

Schwitzer-Cummins Company, for 25 years a leading builder of gear and belt driven automotive superchargers, is now producing this new exhaust driven lightweight turbo charger.

Original specifications called for a gray iron housing. But Schwitzer-Cummins engineers found in practice that unalloyed cast iron failed in this application because hot exhaust gases were causing abnormally high temperatures.

So, they tried Ni-Resist®...

And the result? No failures. None... from scale, cracking or any other cause.

Now, Ni-Resist housings are specified to assure:

1. Resistance to corrosion and erosion by combustion products of chemically treated fuels.
2. Heat resistance up to 1400°F.
3. Good machinability, cutting unit cost.

Other important characteristics of Ni-Resist are selected expansivities, and wear resistance in metal-to-metal service. In fact, *no other cast metal provides such a useful combination of engineering properties.*

In truck, bus, locomotive, marine and stationary power plant engines... in reciprocating aeronautical engines... Ni-Resist has application in exhaust valve guides, aluminum piston ring bands, cylinder liners, exhaust manifolds, connector rings, exhaust seat rings and ball joints and in water pump impellers and bodies.

Several types of Ni-Resist are available to meet a variety of industrial demands. Get full information... mail the coupon now.

The International Nickel Company, Inc.
Dept. 20, 67 Wall Street, New York 5, N. Y.
Please send me booklets entitled "Engineering Properties and Applications of Ni-Resist" and "Buyers' Guide for Ni-Resist Castings."

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SAE 2-54

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THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.


More Profit Time with Less Down Time
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OUT OF SERVICE
MECHANICS Roller Bearing UNIVERSAL JOINTS will give your trucks more road time and less shop time because MECHANICS JOINTS are specially designed with less parts and connections — for easy assembly and servicing — smooth running balance — maximum strength with less weight — and long, trouble-free, safe operation.
MECHANICS JOINTS can be serviced without disturbing other attachments or altering original propeller shaft balance. Let MECHANICS engineers give your trucks or heavy duty machines these competitive advantages.
MECHANICS UNIVERSAL JOINT DIVISION
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MECHANICS
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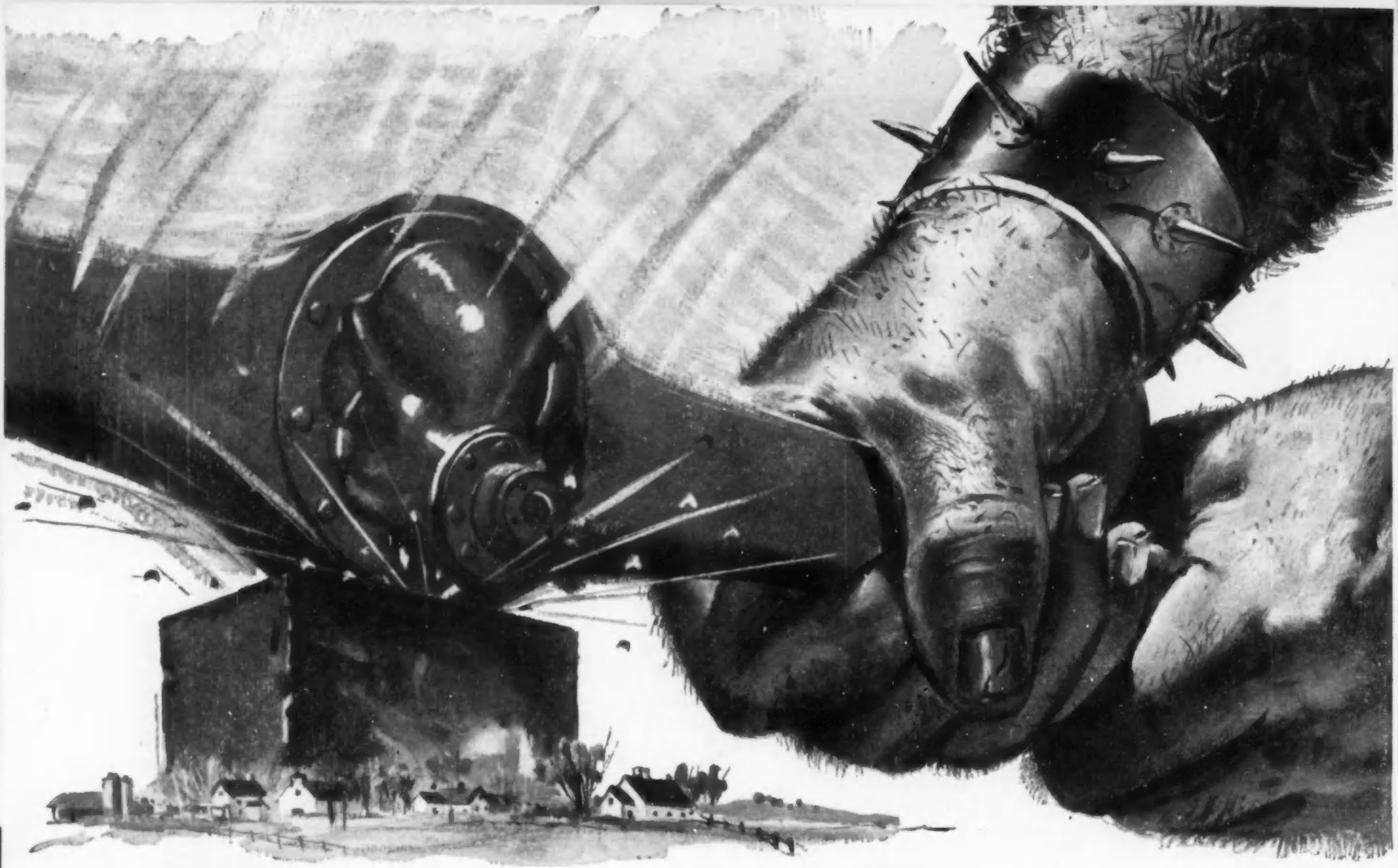
UNIVERSAL JOINTS
For Cars, Trucks, Tractors, Farm Implements, Road Machinery, Industrial Equipment, Aircraft

Spicer has grown up with "the family"

The Spicer organization and the automotive industry were boys in knee pants together. They played in the same yard . . . went to the same school . . . faced the same problems of life together. Spicer has grown up with the automotive industry in every phase of its development.

Spicer products have been an integral part of most American automobiles since 1904. The designing and manufacturing skill gained from producing millions and millions of Spicer units is used by a majority of the manufacturers in the passenger car, truck, bus and tractor fields.



We give truck axles a brutal

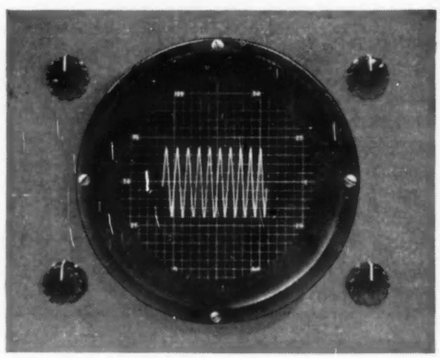
in the new Timken-Detroit indoor proving ground . . . and only

We torture them . . . shock-load, over-speed and jerk them . . . twist, strain and abuse them. We match every on-the-job hauling condition . . . then throw in a few devilish tricks of our own!

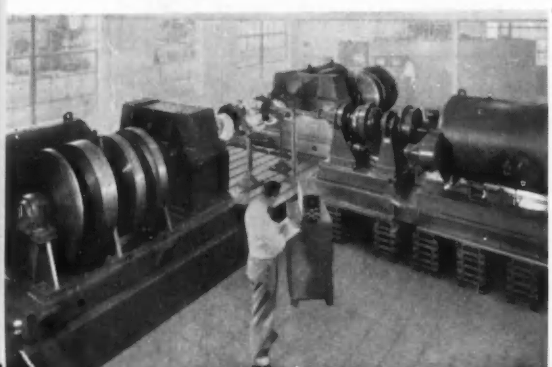
The result? You know for sure that *any* Timken-Detroit axle can take more abuse on the job it was built for than any other axle made!

To prove it, we moved a huge proving ground indoors. In one room we can simulate any hauling situation—our engineers can apply 50 years of experience to perfecting axles for modern trucks, buses and trailers, and measure performance with scientific precision.

This research pays off in longer truck life; less maintenance, repairs and downtime; lower operating costs. No wonder Timken-Detroit axles with Hypoid gearing rate "first" with wise truck owners!



Whatever he hauls . . . simulated service conditions show up electronically on a screen like this. For instance—a heavily loaded truck on a bumpy, twisting road—then on a level express highway or long grade. What happens to the axle and gearing is measured, charted with absolute scientific accuracy.



TDA proves axle quality and performance in this "Torture Chamber"

Here we simulate actual highway conditions . . . test quality and performance of axles under any hauling situation, such as duplicating the kinetic energy of 80,000 lbs., G.C.W., at 60 m.p.h. All tests are repeated hour after hour with an automatic cycling control.

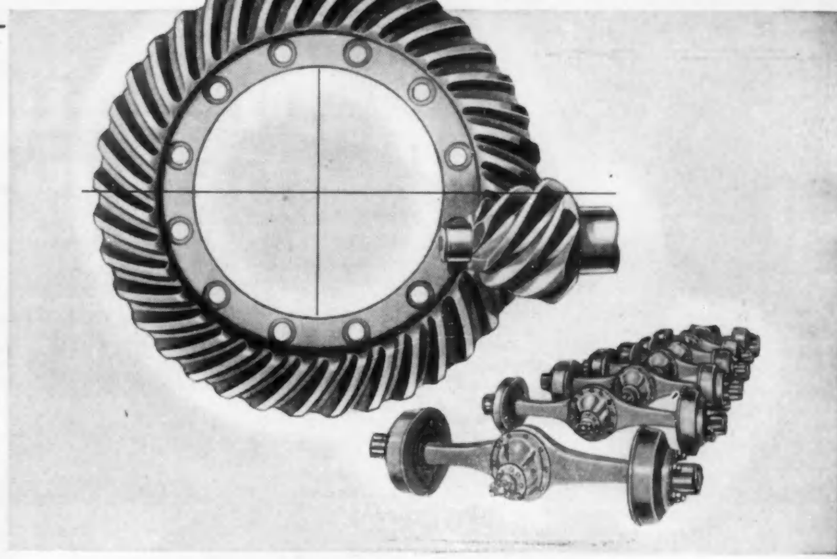
He's hauling perishables . . . he wants axles that will get the payload on the road with plenty of power and speed . . . at low engine r.p.m. He wants low maintenance costs, few repairs, little shoptime . . . long truck life and toughness. He wants Timken-Detroit "Torture-Tested" axles with Hypoid gearing.

He's an intercity hauler . . . he wants axles with pulling power *plus* speed—under any condition . . . without beating the engine to pieces. He wants dependable performance and low upkeep . . . little downtime for repairs . . . long truck life. He wants Timken-Detroit "Torture-Tested" axles with Hypoid gearing.

He's a contract hauler . . . he wants axles that will take him anywhere he needs to go. He wants power and speed where it counts . . . at low engine r.p.m. He wants low maintenance and repair costs . . . little shoptime. He wants Timken-Detroit "Torture-Tested" axles with Hypoid gearing!

beating

Timken has it!



TIMKEN *Detroit* AXLES

TIMKEN-DETROIT AXLE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
DETROIT 32, MICHIGAN

The Accepted DTA Co Standard
TRADE MARK REGISTERED

"TORTURE-TESTED"
to Save Money on the Job

WORLD'S LARGEST MANUFACTURERS OF AXLES FOR TRUCKS, BUSES AND TRAILERS

Next truck you design . . . figure on Timken-Detroit Hypoid gearing

Hypoid gearing for truck axles was pioneered by Timken-Detroit.

Proved in billions of ton-miles of actual operation. Designed to give the slower gear ratios necessary for modern engines without loss of strength. Pinion is bigger, stronger . . . bearings are larger . . . more teeth in contact reducing loading per unit of contact area. Torque transmitting capacity increased to step up performance and rugged power.

Get interchangeability, too!

Only Timken-Detroit has Hypoid gearing in a complete "family" of 7 basic axle capacities—in the entire range of medium and heavy-duty requirements. This advanced-related design incorporates the same features of construction and interchangeability in single-speed; single-speed double-reduction; and two-speed double-reduction final drive units.

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gives them stay-put strength and greater manufacturing ease

Among many vital needs, the great planes of our worldwide defense system require hose connections that are absolutely safe and sound. Here, stainless steel serves with admirable efficiency—resistant to corrosion, tough and strong. • In hose clamp manufacture, SUPERIOR STAINLESS brings extra benefits of exactness in gauge, temper and finish for better workability, finer product performance. *Write us regarding your applications.*

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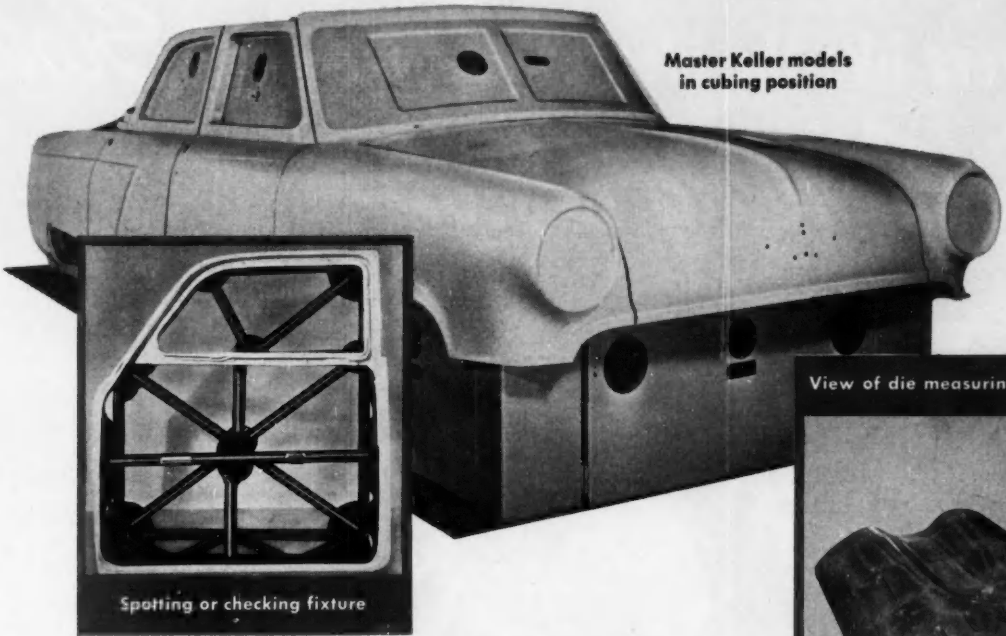

Spotting or checking fixture


View of die measuring 36 x 44 inches

Low-Cost Key to Fast Model Changes—

PLASTIC JIGS, TOOLS, AND METAL-FORMING DIES

Reduction of tooling costs is a basic goal for the automotive and aircraft industries in 1954. A significant contribution to this program will come from the application of BAKELITE Epoxy Resins for metal-forming dies and fixtures.

These resins can be cast into dies without applied heat or pressure, using molds of glass, plaster, wood, or metal. Adding a special hardener converts the resin syrup into a thermosetting solid in a few hours at room temperature. Shrinkage is negligible. Minute mold details are accurately reproduced. The resulting tools are light in weight, with great impact, flexural, and compressive strengths, and excellent dimensional stability. They can be machined or patched when changes are needed.

Laminations of glass fabric and BAKELITE Epoxy Resin are readily constructed for high strength, thin-walled fixtures such as spotting die racks, checking fixtures and Keller models. These devices are accurate and tough, will not check or crack, need no edge binding.

Bakelite Company manufactures epoxy resins and their hardeners. Because of the variety of requirements and formulations, address your problems to us for proper recommendations. Write Dept. TR-72.

Illustrations by courtesy of Ren-ite Plastics, Inc., Lansing, Michigan.

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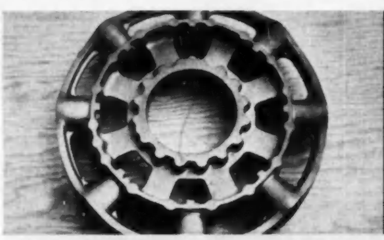

STAINLESS STEEL support ring for jet engine is cast in shell mold made with BAKELITE Phenolic Resins. High degree of accuracy required cannot be achieved by conventional casting methods. Made by The Cooper Alloy Foundry Co., Hillside, N. J.

GLASS AND MINERAL WOOL Fibers in thermal insulation batts are bonded with BAKELITE Phenolic Resins for mechanical strength, rigidity, handling ease. Batts are resistant to moisture, vibration, heat and humidity. Resins also bond asbestos, vegetable fibers.

BRAKE LININGS and frictional elements are made of asbestos and other fillers bonded with BAKELITE Phenolic Resins and baked for permanent shape and hardness. They resist moisture, heat, oil. Later they will be bonded to brake shoe with a BAKELITE Phenolic cement.

Car buyers like the idea of *Driving Slow* without *Slowing Down*

...another instance of Borg-Warner Engineering that helps sell cars

The famous Borg-Warner Overdrive, offered on thirteen leading makes of cars, has many advantages that strengthen the dealer's sales story. For here is the advanced type transmission that lets the engine laze along at 28 miles an hour with the speedometer showing 40. Or, at 42 while moving along at 60. You can *feel* the smoother performance—quiet, free from engine vibration, restful — as B-W Overdrive cuts engine revolutions 30%.

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B-W Overdrive, product of B-W's Warner Gear Division, is a good example of the "design it better—make it better" policy applied to every Borg-Warner product. Proof again that . . . *B-W Engineering makes it work—B-W Production makes it available.*

Year by year you find B-W Overdrive on the cars with the best mileage per gallon in the Mobilgas Economy Run.

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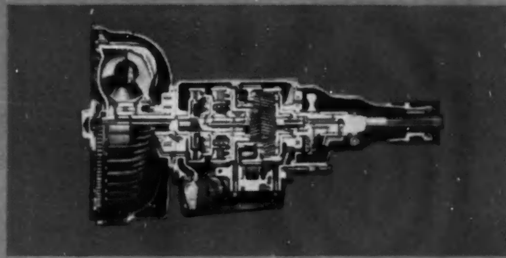

the new
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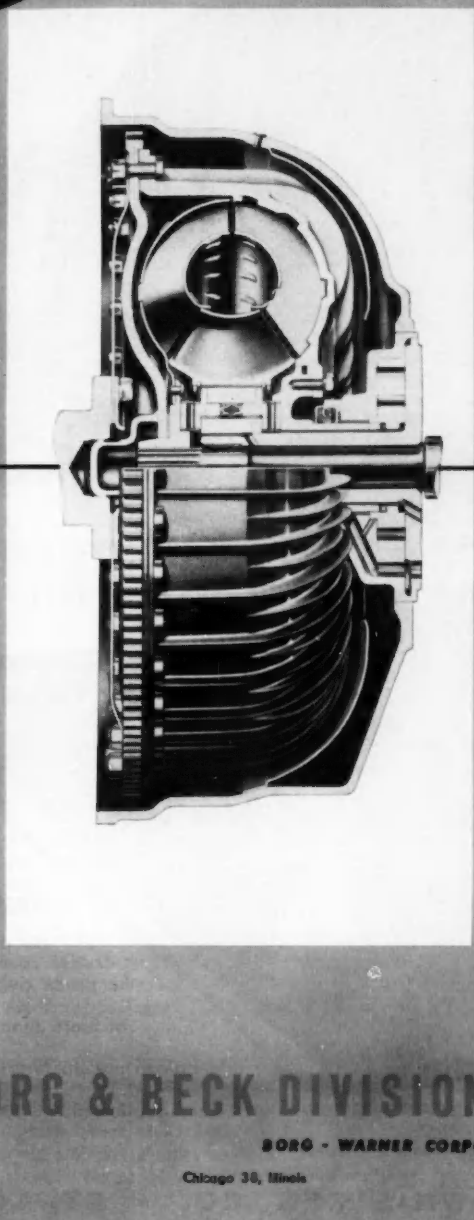
TORQUE CONVERTER

used in Fordomatic and Merc-O-Matic transmissions



An air-cooled Torque Converter of unique design with steel blades assembled in die-cast aluminum Impeller whose 68 fins provide swift cooling.

The Turbine is made of steel stampings and the Stator is aluminum. Its One-Way 20 sprag clutch is Borg-Warner's well-proved design.

Light in weight, with a torque ratio of 2.1:1, it has excellent efficiency, yet it can be readily disassembled in the field for inspection or repair.

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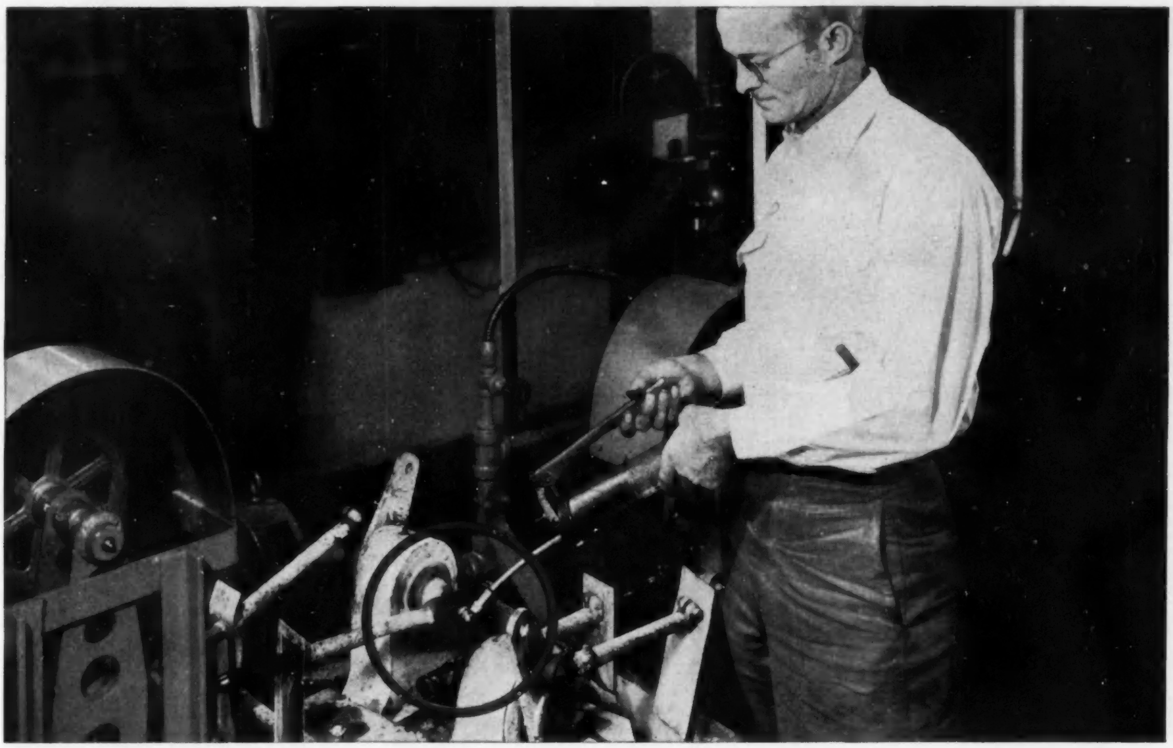
You can count on

Thompson's Performance-Tested steering linkage



THIS "CAR" TRAVELS 1500 MILES A DAY!

IT'S not a *whole* car, of course. Just the important center link of a Thompson precision-made steering linkage. In the above picture, the center link is getting its daily . . . yes, *daily* . . . 1500-mile lubrication!

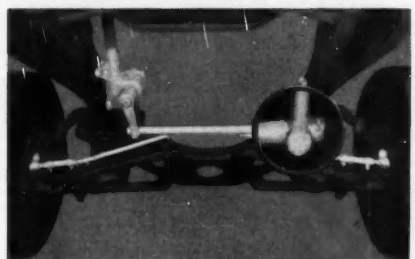
AROUND THE CLOCK—This is part of a grueling Performance Test that goes on in Thompson's Testing Laboratory 24 hours a day. Here the most extreme, difficult road conditions are duplicated. The Thompson steering link is subjected, hour after hour, day after day, to baths in mud and water . . . dry spells . . . jarring jolts of 300 pounds or more . . . and grinding, burning friction.

And, in addition, these rugged tests are supplemented by actual trial runs out on the road in standard-make cars.

WHY THESE TESTS? Because Thompson is continually striving for *improvement* . . . in materials, in performance, in manufacturing procedures. New materials, new processes, new designs are all subjected to these thorough Performance Tests . . . and always under the most extreme conditions.

THE RESULTS? These exacting tests in the laboratory and out on the open road . . . plus periodic skilled analyses by experienced Thompson engineers . . . result in the finest possible steering linkage for America's cars, trucks, buses and tractors.

If you have a steering linkage problem, let Thompson's steering engineers help you. Just write or phone Thompson Products, Inc., Michigan Plant, 7881 Conant Ave., Detroit 11, Mich., WA 1-5010.



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Our Engine Bearings are specified as original equipment by the leading names in motordom because they have consistently contributed to better performance for more than a quarter century.

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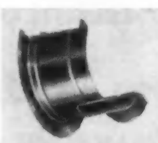

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SMALLER IN SIZE ...BIGGER IN OUTPUT!

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only 8-1 16" x 8-5 16" x 8-3 8"

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17,800 BTU Output

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"Continuous service" bus type motor — heavy duty truck service core

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Simple to connect to top or side cowl for fresh air intake

Provides more heat output than any other heater-defroster of its size

Each Evans unit is custom engineered for its specific vehicle installation, to provide a completely satisfactory heating and ventilating system. Evans units are available for a wide variety of commercial vehicle applications.

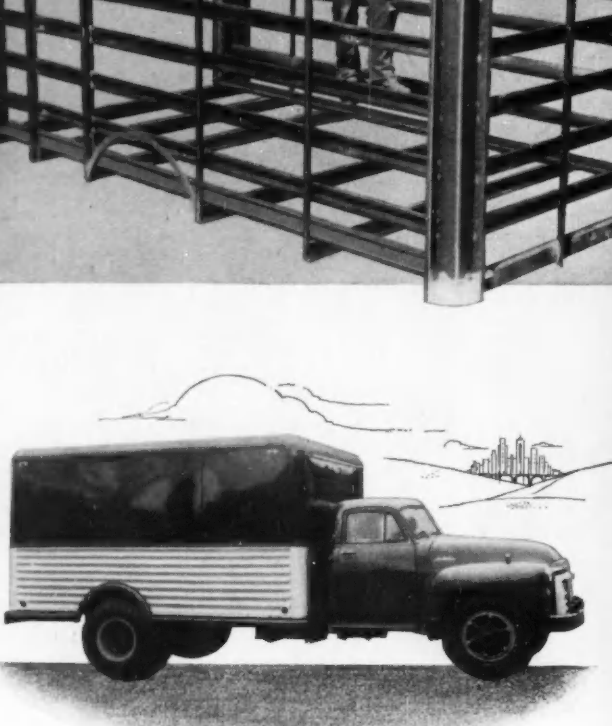
The Evans organization is staffed to engineer units to specification, organized to build prototypes quickly, equipped to conduct precision tests to latest A.S.H.V.E. procedures. Military experience dating back to World War I qualifies Evans to work with you in meeting the rigid specifications of the Armed Forces. If your needs are for high performance, ruggedly constructed equipment—it will pay you to consult Evans Products Company, Heating & Ventilating Division, Dept. Z-2, Plymouth, Mich.

EVERY EVANS HEATER IS EQUIPPED WITH THE FAMOUS EVANS UNBREAKABLE LIGHTWEIGHT FAN

Precision die-molded airfoil section blades . . . move more air with less noise and current draw . . . will not chip, crack or bend . . . unaffected by temperature . . . one piece construction.

EVANS ... BALANCED HEATING & VENTILATING CUSTOM HEATERS ... FOR EVERY TRUCK AND BUS

Mayari-R



makes Proctor-Keefe body-frames 30% lighter

This unit is typical of the modern, light van bodies turned out by Proctor-Keefe Body Company, Detroit. Of steel construction throughout, the parts are scientifically welded, bolted and riveted for maximum strength.

Jig-formed sections of Mayari R are used as framing to give the necessary strength, yet cut deadweight to the bone. These Mayari R sections actually make the framing about 30 pct lighter than the previous type of construction.

No matter what type of vehicle you make—gigantic trailers, light delivery trucks or passenger cars—you can find profitable applications for Mayari R high-strength, low-alloy steel. You can weld it, form it, machine it with the same equipment you're using now. And Mayari R will hold paint up to 80 pct longer than carbon steels, resist corrosion 5 to 6 times longer, and take a lot more battering and abrasion.

Send for a copy of our new Mayari R catalog, to see the many interesting ways in which the automotive industry is using this versatile, weight-saving steel. Phone or write our nearest office for a copy, or write to the address below.

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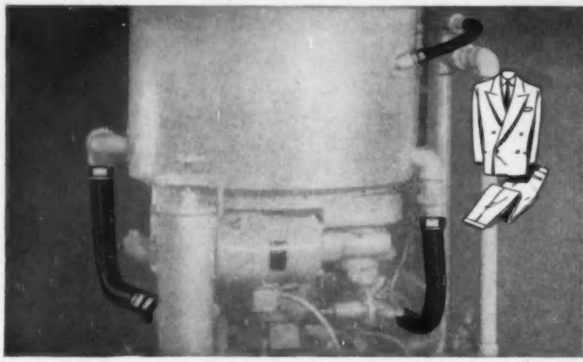
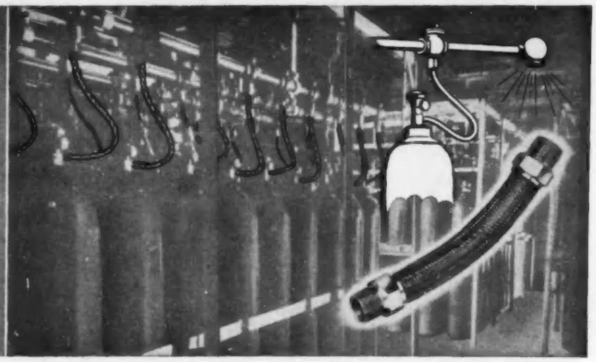
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Mayari R *makes it lighter... stronger... longer lasting*

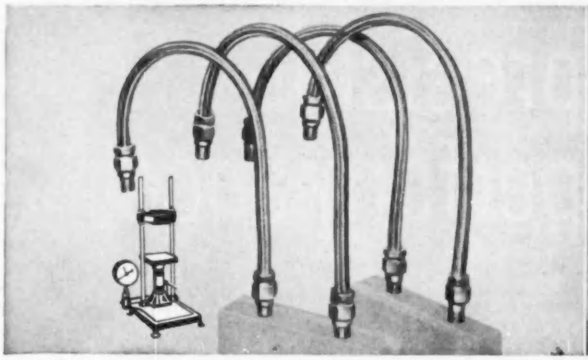
Pick an idea—lick a design problem...

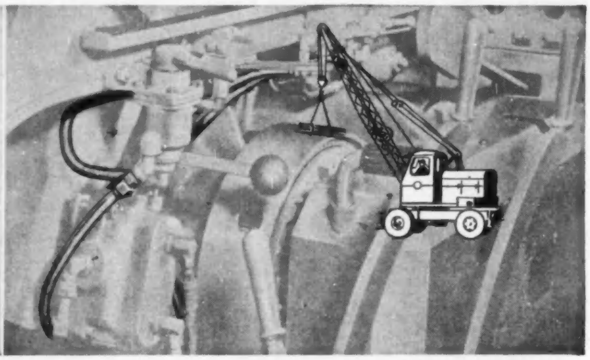




END VIBRATION AND LEAKAGE. Titeflex® metal hose, used as fill and drain lines of SEC Synthetic Cleaning Units, kills vibration and prevents solvent leakage at fittings. Tough, wear-and-corrosion-resistant Titeflex is just as effective in handling steam, oil, lubricants, fuels, gases, brine, acids, compressed air or oxygen. Design and construction of Titeflex assure trouble-free performance. Excellent for projects involving extreme configurations.

CONTROL CRITICAL PRESSURES. How would you connect 280 cylinders of fire-extinguishing carbon dioxide at 850 psi to line? Walter Kidde & Company licked this problem with Titeflex flexible metal hose which met all insurance standards and withstood rigid application requirements. Titeflex also conveys hundreds of different fluids under as many different temperature and pressure conditions. Resists corrosion, vibration, physical abuse.





CONDUCT STEAM SAFELY. Plates for Carver Laboratory Press carry steam up to 200 psi (nearly 400°F.) for heating—water for cooling. The connections are flexible, pressure-safe Titeflex. Braiding gives extra strength. Added problems of vibration, pulsation, continuous movement, corrosion or abrasion make Titeflex invaluable in scores of other applications.

FIGHT FATIGUE AND WEAR. Titeflex metal hose eliminated maintenance on air control lines of Unit Mobile Cranes. All-metal construction, with braiding woven directly upon the hose, provides great strength and resistance to vibration, corrosion, wear and abuse. Flexibility of Titeflex permits simplified assembly even where space configurations are problems.

THE USES FOR TITEFLEX® seamed flexible metal hose and Uniflex seamless flexible metal hose are limited only by engineering ingenuity. And Titeflex design engineers—working *with* customers—develop new applications daily. Somewhere in your plant or on your products Titeflex can improve operation and maintenance—or simplify a design problem. Our *new 48-page Metal Hose Catalog* No. 200 shows you how and why. To get your free copy, simply mail the coupon.

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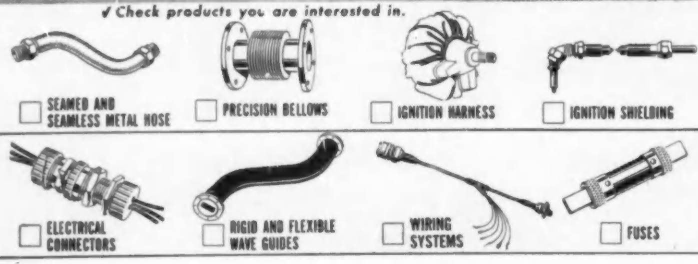

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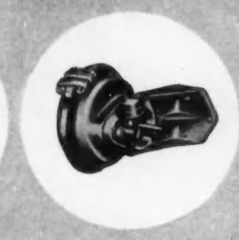
now... air brakes for light trucks!

New small-size Bendix-Westinghouse TU-FLO Compressor brings the extra power, faster action, greater economy of air braking to the lightweight field!

New Type E Treadle Brake Valve



New Air-Hydraulic Actuators

Now, operators of lightweight trucks can cash in on all the benefits of the world's most effective and efficient braking power—AIR! Yes, now you can enjoy the faster, smoother, more effortless stops and positive braking control possible only with air brakes. You'll enjoy added reliability and economy, too, for actual fleet records prove maintenance costs of air brakes are lower than any other type of braking system.

TU-FLO 300 COMPRESSOR — GIANT IN PERFORMANCE, MIDGET IN SIZE! This new Bendix-Westinghouse two-cylinder reciprocating piston-type compressor makes the lightweight system possible. Stands less than 8½ inches high, weighs only 14 pounds. Is quiet running, air-cooled and has new unloading mechanism and new design inlet valves.

NEW TYPE "E" TREADLE BRAKE VALVE—Drivers like the "feel" of this new valve—a slight foot depression and AIR does all the work. Full-graduating characteristics provide for safer, surer braking at all times.

NEW AIR-HYDRAULIC ACTUATORS—A new line of these actuators assures a proper size and mounting to suit all hydraulic master cylinder requirements. Compact, dirt-proof, require no lubrication and practically no maintenance.

NOW AT YOUR BENDIX-WESTINGHOUSE DISTRIBUTORS—This new system is available in handy, easily installed kits designed to fit every make and model lightweight vehicle. Stop in and take a demonstration ride today!

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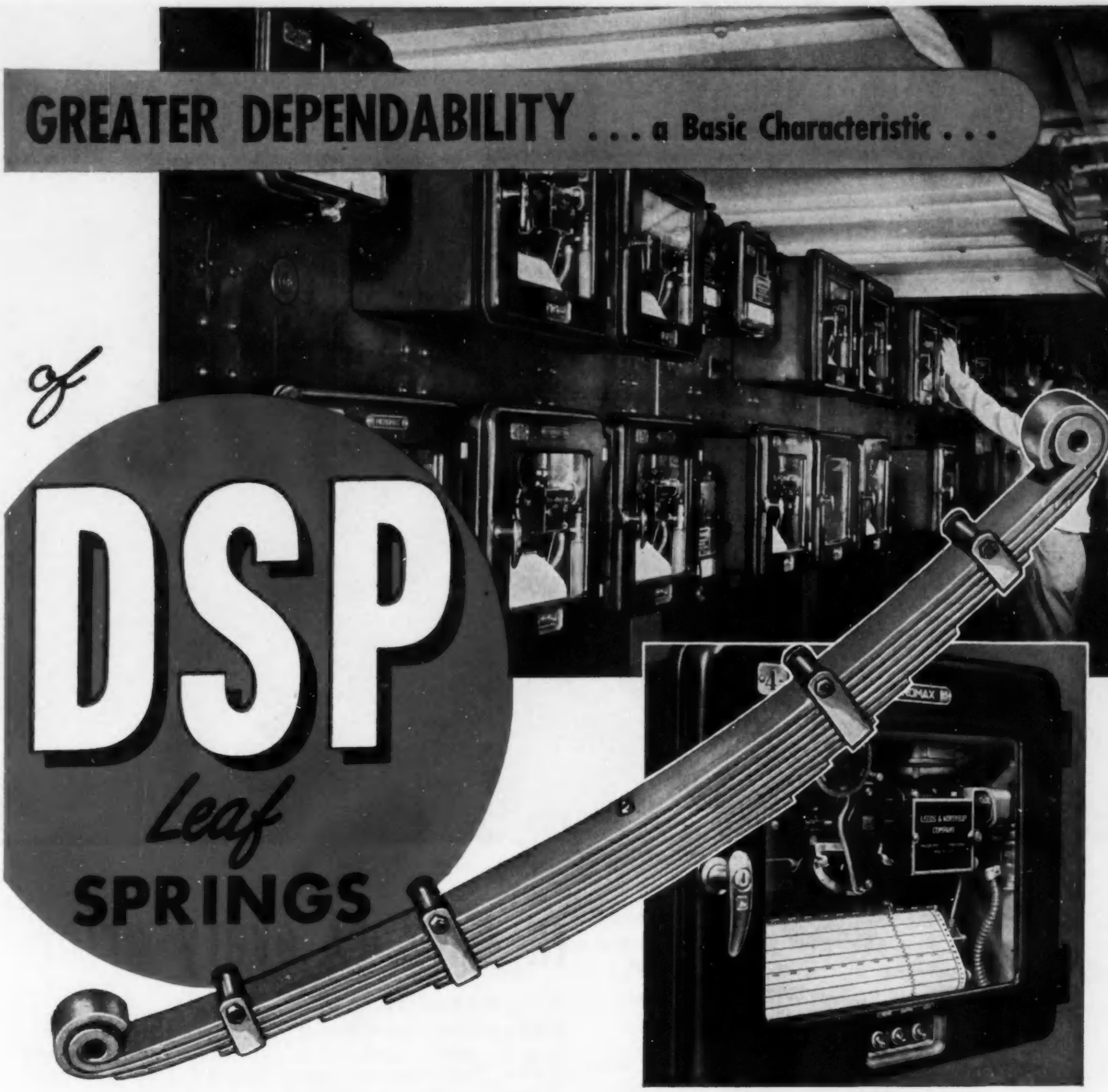

... is established by exacting temperature control during manufacture

In the production of DSP Leaf Springs, centrally located heat controls automatically maintain accurate and constant temperatures during the quench-forming and drawing operations. These pyrometer controls, on each of our various furnaces, limit temperature variances to plus or minus 10°.

Instruments, such as the above, have played an important part in the manufacture of DSP Leaf Springs since 1904. They are part of a production pattern which gives you springs of "GREATER DEPENDABILITY" . . . another reason why *the makers of most of America's trucks use DSP Leaf Springs as original equipment.*

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Sealed Power has made over 70,000,000 transmission sealing rings since the advent of automatic transmissions. Starting before World War II, Sealed Power made millions of such rings for tanks and now makes them for passenger cars, trucks, buses, and tanks. Of the 19 makes of cars now using automatic transmissions, 16 use Sealed Power Sealing Rings.
The function of a sealing ring is to seal oil pressure. It must be efficient in its job. It must be easy to assemble. Through 16 years of research and testing, Sealed Power has been outstandingly successful on both counts. Sealed Power manufactures sealing rings from one inch to 14 inches in diameter, and can make them in any size to meet any requirements. Let us use our experience and our facilities to help you make your good products even better.
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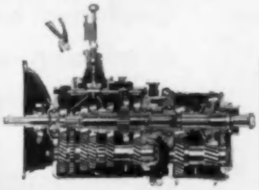
Sealed Power Chrome Piston Rings are used by 25 leading engine builders

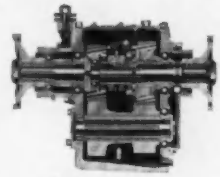
more goods *faster*

From oil to oysters, shirts to steel—modern truckers are boosting business in every industry by hauling *more* goods *faster*. Stepped-up round-trip schedules call for plenty of horses under the hood—delivered through gears with the *right* ratios . . . gears that *shift fast* and *easy* . . . gears that go more miles with *less* maintenance. That's why more truckers today are *specifying* Fuller Transmissions.

10-speed, single-lever Fuller R-95-C ROADRANGER® Transmissions boost round-trip time on International Tractors used by Johnson Motor Lines to haul textiles.



R-95-C



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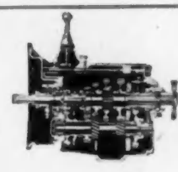
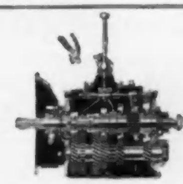


5-C-72



5-A-1120

Fuller 5-A-1120 Transmissions—on Model 910N Diamond T's used to haul oil for Southern Oil Transportation Company—shift fast and easy with 30 tons GVW.

This Ward LaFrance—hauling 40-ton brake shoe for Ross Transport Co., Ltd., South Africa—makes round trips up to 3800 miles. Main transmission is Fuller 5-C-72; auxiliary is Fuller 3-B-92.

110 Models

50 HP TO 400 HP

For any type engine ranging from 330 to 1440 inches—on any type on- or off-highway truck or powered equipment—Fuller's complete line offers a Transmission with the right speeds, the right ratios, to meet the most exacting job requirements.

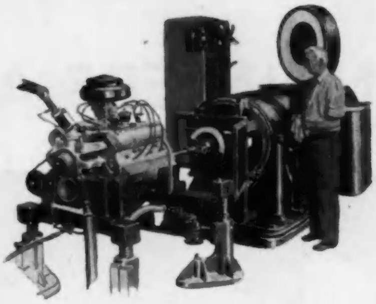
Fuller TRANSMISSIONS®

FULLER MANUFACTURING COMPANY (Transmission Division), KALAMAZOO, MICHIGAN

Unit Drop Forge Division, Milwaukee 1, Wis. • Western District Branch (Sales & Service—Both Divisions), 641 E. 10th St., Oakland 6, Cal. • Shuler Axle Co., Louisville, Ky. (Subsidiary)

Typical of special test equipment built in our shops—this one for testing trailer floors.

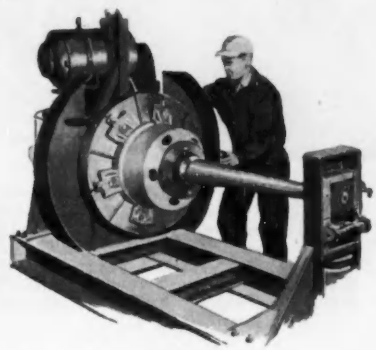
Drive-in deep freeze for testing automotive parts in use at low temperatures.



Electric dynamometer for testing internal combustion engines.

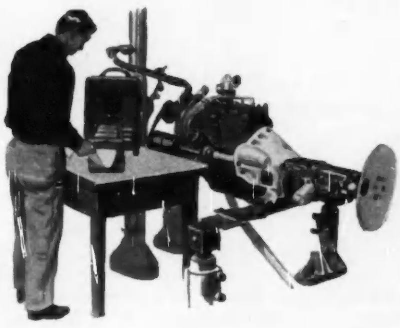
Fatigue testing machine applying fatigue loads to the skirt of a piston.

Vibrator table which accurately controls vibrations to check metal fatigue on automotive parts.

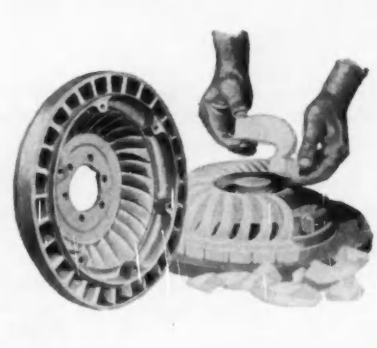


Wheel testing machine, designed by Alcoa, tests various types of wheels under simulated road conditions.

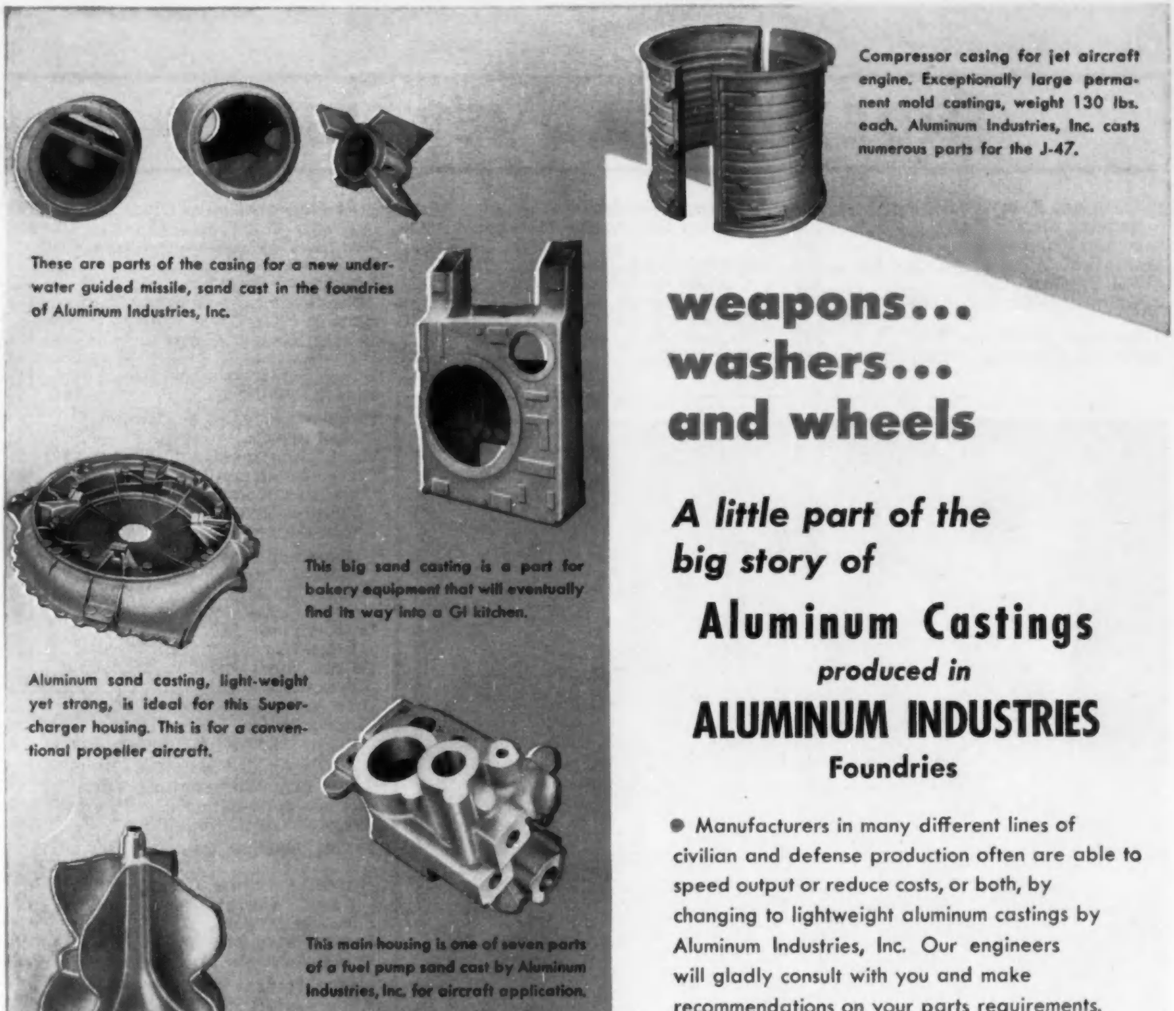
Whirl pit for testing rotating parts up to 80,000 rpm.



Stress analysis and fatigue test of die-cast aluminum clutch housing.



Automotive torque converter cast from special Alcoa-developed plaster cores.


Compressor casing for jet aircraft engine. Exceptionally large permanent mold castings, weight 130 lbs. each. Aluminum Industries, Inc. casts numerous parts for the J-47.
These are parts of the casing for a new underwater guided missile, sand cast in the foundries of Aluminum Industries, Inc.
weapons... washers... and wheels
A little part of the big story of
Aluminum Castings
produced in
ALUMINUM INDUSTRIES
Foundries
This big sand casting is a part for bakery equipment that will eventually find its way into a GI kitchen.
Aluminum sand casting, light-weight yet strong, is ideal for this Supercharger housing. This is for a conventional propeller aircraft.
● Manufacturers in many different lines of civilian and defense production often are able to speed output or reduce costs, or both, by changing to lightweight aluminum castings by Aluminum Industries, Inc. Our engineers will gladly consult with you and make recommendations on your parts requirements.
This main housing is one of seven parts of a fuel pump sand cast by Aluminum Industries, Inc. for aircraft application.
ALUMINUM INDUSTRIES, Inc.
CINCINNATI 25, OHIO
New York: 9 Rockefeller Plaza
Detroit: 809 New Center Bldg.
Chicago: 64 E. Jackson Blvd.
Washing machine agitators, cast by the permanent mold process, are a peacetime product of the Aluminum Industries, Inc. foundries.
Pistons of all types are cast by Aluminum Industries, Inc. This small piston and the connecting rod are permanent mold castings for small utility engines.
The diversity of castings produced in Aluminum Industries, Inc. foundries is endless. These aluminum sand castings are caster wheels for industrial trucks.
PERMITE Aluminum Castings
ALUMINUM PERMANENT MOLD and SAND CASTINGS... HARDENED, GROUND and FORGED STEEL PARTS

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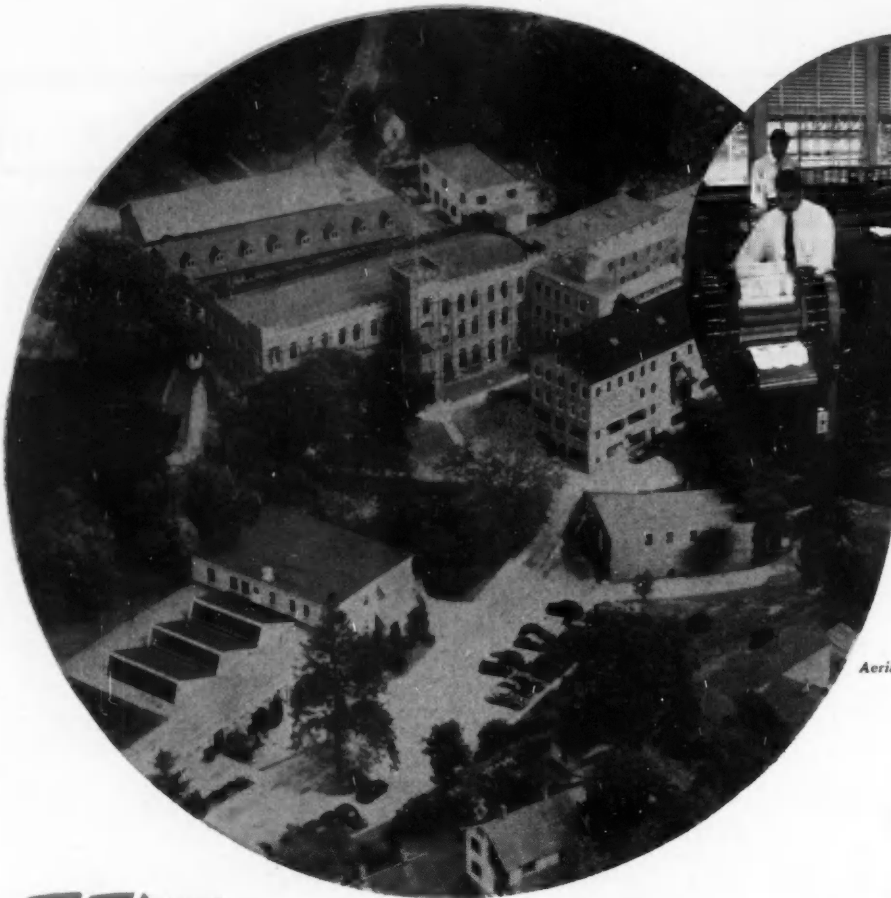

Aerial view of Glenville Plant

FELT problems are welcomed here AND SOLVED!

American makes felt in actually hundreds of different types, each having carefully-controlled characteristics. Felt, you see, is not just felt, but is an engineering material, which can be, and should be, selected and specified as closely as any other material.

American is keenly progressive and has a vast knowledge of all types of natural and synthetic fibres. Felt is now engineered into the various end uses. Our knowledge is freely available to you, through our sales staff, or from the Engineering and Research Laboratory.

How important it is to obtain the right felt is illustrated by the case of a customer who insisted on "saving money" by buying a felt which we insisted was not suitable for the application. In the end, the saving produced a loss, and the customer, having learned the hard way, now relies upon our advice. You can avoid such trouble by bringing your needs for felt to American. Tell us what the felt is to be used for, whether in a process or a product, and we will help you select the right type.

And remember, American operates cutting shops in Glenville, Conn., Detroit, Mich., San Francisco, Calif., which can quickly produce cut felt parts, ready for assembly, to speed your output.

American Felt Company

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